THE ENGLISH ACADEMY:

Or, A Brief
INTRODUCTION
TO THE
SEVEN LIBERAL ARTS.

Grammar,	*Astronomie*,
Arithmetick,	*Rhetorick*,
Geometrie,	&
Musick,	*Logick*.

Chiefly intended for the Instruction of Young Scholars, who are acquainted with no other than their Native Language; But may also be very useful to other Persons that have made some progress in the Studies of the said Arts.

By *John Newton*, D. D.

Author of Trigonometria Brittanica

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TO THE
READER.

I Have perhaps troubled thee and the Press already too much; if it be so, I shall however hope, that I am not unpardonable, because I have still intended well to the good of the Publick; every one I think desires to give their Children the best Education that they can; but the highest degree of Education is not always best: And I must beg thy Pardon, if I do offend thee,

A 3

What be'st thee a Quaker

thee, in saying, That next to the
bare Reading of *English*, the sen-
ding of Children to the *Latin*-
School, is not the beft way of
giving them Education, for if
that were granted, which I muft
deny, That the *Latin* and *Greek*
Tongues were not only neceffary
for all Children whatfoever, but
alfo more eafily learned, than
the liberal Arts ; yet *Writing* is fo
neceffary to be firft Learned, that
it is almoft impoffible to attain the
other without it.

And as *Writing* is very neceffary
in order to the *Latin* and *Greek*
Tongues, fo is it alfo neceffary
in order to the true Spelling and
Underftanding of the *English*, or
any other Native Language ; and
indeed the Art of *Grammar* is the
only One of the Seven, that
claimes a propriety in every Na-
tive

tive Language : As for the other Arts, they are the fame, in all Languages, the Rules of *Arithmetick* and *Geometry*, of *Mufick* and *Aftronomy*, of *Rhetorick* and *Logick*, are in the General, as Intelligible in every Language, as in the *Latin* and *Greek*, or any other ; and therefore to them, that have no other need of the *Latin* and *Greek* Tongues , than the Learning of thefe Arts, may, I conceive, fpare that pains, and Learn them in their own Native Language, or as many of them, as will be thought ufeful for them, in their feveral Stations in the World.

Again, thefe Arts are not only attainable in every Native Language, but more eafily attainable than the *Latin* and *Greek* Tongues are, to which fome feem

defirous

desirous to confine the Arts; and being so attained, do render other Languages more easie also.

For these, and the like Reasons, as I have already Published distinct Introductions to every Art, except *Musick*; for which I refer thee to Mr. *Joh. Playford*'s Introduction; so now I have been easily perswaded, to give thee a short view of them altogether; he that desires more full Instruction, may peruse the several Tracts by me Written, in our own, or those that are written by other Men in other Languages. The whole Building is but small, and therefore I will not make the Porch great, I have placed the Arts in that Order, in which, (with submission to better Judgements) I do conceive they should be learned: And although I cannot say now, as I have in some of my

Epistles

Epiftles preceding my former Tracts, that there is not fo much as one *Mathematical School* in *England*, for now there is by His Majefties Bounty a fair Foundation laid in *Chrift-Church-Hofpital*, *London*, and one chofen to Manage it, by Name Mr. *J. Leake*, who is fo well known, that he needeth no Mans Commendations to exprefs his Worth ; Yet thus much I ftill declare to be my Opinion, That it is more proper, that the *Latin* School fhould be fupplied with Scholars from the *Mathematical*, than that the *Mathematical* fhould be fupplied from the *Latin* and *Greek* Schools s However by this means, I hope it will come to pafs, that afterages will be fupplied with that Knowledge in *Arithmetick*, *Geometry*, and *Aftronomy*, which hitherto our *Writing*-Mafters have

not

not been able to Teach, nor our
Grammar Mafters either able or
willing to undertake ; fo that in
a Word, There are few Country
School-Mafters that can Teach
thefe things : But yet amongft
them, the well Accomplifhed
Mr. *Perkins* of *Guildford*, with
whom I have not had the happi-
nefs to be immediately Acquain-
ted, yet Report hath rendred him
to the World a worthy Mafter
and Teacher of that Science. And
there are not many Tutors in
either of our Univerfities that
do; and yet the ufefulnefs of
thefe Arts cannot be denied,
and therefore my hopes are, that
fome Univerfal Encouragément
will yet be given for the Teaching
of them.

And could I be fo happy, as to
fee fomething done in order to it,

I

should think my self abundant-
ly satisfied for all the Pains I have
hitherto taken, and shall ever
rest,

Thine and his Countrys Servant,

JOHN NEWTON.

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THE
PREFACE
OR
INTRODUCTION
TO THE
Arts and *Sciences* in the General.

Wisdom is the Principal *thing*, and therefore *saith* Solomon, Get Wisdom, and with all thy getting, get Understanding. Prov. 4. 7. and *what is meant by Wis-*dom, *Holy* Job *tells us*, Job 28. 28. Behold the Fear of the Lord, that is Wisdom, and to depart from Evil, that is Understanding. *They who seek*

for

for this Wisdom, are the only true Philo-
sophers; *for Philosophie is nothing else
but the love of wisdom, and they who
Fear God, and depart from Evil, are the
lovers of that, which is the only real and
true Wisdom: Now for as much, as we
cannot be said to fear God, except we know
him, Wisdom may well be defined to be
the Knowledge of God and the things that
are of him, the knowledge of things Di-
vine and Humane, and this is commonly
called* Philosophie, *but somewhat impro-
perly, for* Philosophie *is not properly the
Knowledge it self, but the love of that
Knowledge; and whatsoever* Art or Sci-
ence *doth conduce to this Knowledge, may
be rightly and truly called* Sophia, *or* Wis-
dom; *and because all Men should love
such knowledge and Delight in it, I shall
not gainsay the general Name by which it
is called, custom will have it so, let it
therefore be called* Philosophy.

Sophia *then, or* Philosophia, Wisdom,
or the love of Wisdom, *is the Knowledge
of all Arts and Sciences, which any way
do conduce to the Knowledge of God: And
because some of them do thereunto conduce
more, some less: These arts may be distin-*
guished

guished into two Sorts, Superiour and Inferiour.

The Superiour Arts are four;

1. Theologie or Divinity, whose Subject is the Divine Essence.

2. Metaphysicks, otherwise called the first Philosophy, whose Subject is, Being in common, or Being as Being.

3. Physicks, whose Subject is the Knowledge of Natural Bodies, as they are Natural.

4. Ethicks, whose Subject is Morality, or the Doctrin of Manners and civil Honesty.

The Inferiour Arts are of two sorts;

1. Internal or Liberal Arts, so called, because they are attained by the Faculties of the Soul, which is a liberal or free agent, and not by the Labour or Ministry of the Hands; and these are seven:

1. Grammar, } 5. Astronomie,
2. Arithmetick, } 6. Rhetorick,
3. Geometrie, } 7. Logick.
4. Musick, }

And

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And these are the Subjects of this little Book.

2. *The* External *or* Mechanical *and* Manual Arts, *so called, because they depend more upon the labour of the* Body, *than the* Mind; *such are the Arts of* Tillage, Hunting, Fishing, Fowling, Weaving, *and many more, not needful to be named, because no part of the ensuing Discourse.*

THE

THE *ENGLISH* ACADEMY.

The FIRST PART.

OF GRAMMAR.

BOOK I.

CHAP. I.

Of Letters and Syllables.

Grammar is an Art which Teacheth how to Speak and Write truly.

The Parts thereof are Four, Letters, Syllables, Words and Sentences.

A Letter is a Character, or Index, of a simple sound. And in the *English* Tongue there are Twenty four.

The which Letters are distinguished from one another, partly by their shapes, and partly by their sounds.

B

In reference to their shapes, they are distinguished by three different Characters, the Roman, Italick, and black English.

And in each of these Characters there is the great and the small Letter.

In the Roman Character, the great Letter is thus formed,

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

The small thus,

a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, ſ, s, t, u, v, w, x, y, z.

The great and small Italick Letters are made thus,

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, ſ, s, t, u, v, w, x, y, z.

The great and small black English thus,

A, B, C, D, E, F, G, H, I, K, L, M, N, O, P, Q, R, S, T, U, W, X, Y, Z,

a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z.

The great Letters are used in the beginning of proper Names, Emphatical words, Sentences, and Verses. The Letter I when it stands alone, is always written with a great Character.

Theſe

These Twenty and four Letters are divided into Vowels and Consonants.

A Vowel is a letter which maketh a full and perfect sound of it self, and they are five, *a, e, o, u*, besides the *Greek* Vowel *y*.

A Consonant is a letter which maketh a sound by help of a Vowel, and these are Eighteen, besides the letters *j*, *v*, and *y*, which sometimes are Consonants also.

Of the eighteen Consonants, some are mutes, as these eight, *b, c, d, g, k, p, q*, and *t*. Some Semi-Vowels, as these eight, *f, l, m, n, r, s, x*, and *z*, of which these four, *l, m, n, r*, are also called Liquids, *x* and *z*, double Consonants, and the other two, *h*, and *w*, irregular letters.

Some of these Letters, as well Vowels as Consonants, have sounds very different from their common names. Thus the letter *c* before *e* and *i*, is sounded like *s*, but before *a, o, u*, it is sounded like *k*, as in *cancel, cur*.

The Letter *f*, is sometimes sounded according to its usual name, as when it follows a Vowel, as in *if, of, effeminate*, but when it begins a Word or Syllable, it is sounded *ef*, as in *feet, foolish*.

The Letter *g*, before *a, o*, and *u*, is sounded hard thus, *ghee*, as in *gad, God*, but before *e* and *i* it is sometimes, but not always, sounded according to its usual name *gee*, as in *danger, ginger*.

The Letter *h* is never sounded according to its name *ach*, but thus, *hee*, as in *hand, help*, *him*.

The Letters *j* and *v*, when they come be-
fore themselves or any other Vowel in the same
Syllable, become Consonants and have different
sounds from their usual names, *j* is pronounced
like *g*, soft, thus *ji* is pronounced like *gi*, in *gin-
ger*, *u* is pronounced *vee*, or *vu*, as in *vanish,
vine*; and when they are thus sounded, their
shape is also changed, and hence some would
have them to be distinct Letters, and would
have the number of our Letters to be not 24,
but 26.

The Liquids *l*, *m*, *n*, and *r*, when they begin
a Word or Syllable, are sounded thus, *lee*, *mee,
nee*, *ree*, as in *light, mind, need, read*.

The Letter *q*, hath alwayes *u* after it, to help
its sound, but is not to be sounded according
to its name *eu*, but *que*, as in *question*.

The Letter *ſ*, when it begins a Word or Syl-
lable, is to be sounded thus, *see*, as in *sad, secret*,
but in the end of a Word, or between two
Vowels or Diphthongs, it hath for the most
part the sound of *z*, as in *easie, bosom*.

The Letter *t*, before *i*, if another Vowel fol-
loweth hath the sound of *si*, as in *Egyptian,
patience*; but when it followeth *ſ* or *x*, it hath
its own proper sound, as in *bestial, mixtion*.

The Letter *w*, hath its name from its shape,
being composed of twice *u*, it is called double *u*,
but is in no case so sounded, but *we*, as in *wall,
well, will*.

The Letter *x*, when it begins a Word or Syl-
lable, is sounded thus, *xee*, as in *Xerxes*; in
other cases thus, *ex*, or *ecs*.

The Letter *y*, hath by no means its found according to its usual name *wi*, but when it begins a Word or Syllable, and so becomes a Consonant, it is founded *yee*, when it comes in the middle or end of a Word, it is founded like Vowel, as in *my*, *thy*.

The Letter *z*, is to be founded *zee*, as in *zeal*.

A Syllable is a literal or articulate Voice of the individual found.

Syllables are of two forts, improper and proper.

An Improper Syllable is made of one or more Vowels without a Consonant, as *a-ny*, *e-vil*, *Æ-neas*, *Oe-dipus*.

A Proper Syllable is the comprehension of one or more Consonants, with one or more Vowels, in one found or breath; as *Ge-ne-ra-ti-on*, *Moun-tain*, and in our *English* Tongue doth sometimes consist of eight Letters, as *strength*.

When two Vowels are joyned together in one found or breath, they are called Diphthongs; of which there are two forts, Proper and Improper.

Of proper Dipthongs, there are these eight, *ai*, *ei*, *oi*, *au*, *eu*, *ou*, *ee*, and *oo*.

The first six are sometimes written thus, *ay*, *ey*, *oy*, *aw*, *ew*, *ow*.

Of improper Dipthongs there are but these three, *ea*, *oa*, and *ie*.

The two Vowels which make a Dipthong, are for the most part to be founded together,

as

as in *Faith*, *neither*, *Eunuch*, but in thefe words,
Laity, *Mofaick-work*, *Deity*, *Atheift*, *moity*, *doing*,
reenter, *reiterate*, and fuch like, and in moſt
Proper Names in the Bible they are to be foun-
ded feverally.

The Improper Dipthongs *ea* and *oa*, are
founded together, except in thefe Words,
beatitude, *creator*, *creation*, *real*, *theatre*, and moſt
proper names of Women, Cities, and Coun-
tries; but the two Vowels in this Dipthong
ei, are ufually parted, except in thefe two
Words, *friend*, *grief*, and when they come in
the end of a Word, as in *mercie*, *charitie*, and
fuch like.

An *Englifh* Syllable, though it may confiſt of
eight Letters, yet doth it never begin with
more than two Vowels before a Confonant, or
three Confonants before a Vowel or Dipthong.

The two Confonants which may begin an
Englifh Word or Syllable are thefe thirty,
Bl, *br*, *ch*, *cl*, *cr*, *dr*, *dw*, *fl*, *fr*, *gl*, *gn*, *gr*, *kn*,
pl, *pr*, *fc*, *fh*, *sk*, *fp*, *ft*, *fm*, *fn*, *fq*, *fw*, *th*, *tr*, *tw*,
wh, and *wr*.

And the three Confonants that may begin
an *Englifh* Word are thefe nine, *Sch*, *fcr*, *fhr*,
skr, *fpl*, *fpr*, *ftr*, *thr*, *thw*.

In the founding of the Confonants which are
joyned together in the beginning of a Word,
there is no difficulty, but in thefe few, *ch*, *gh*,
and *th*.

The Letters *ch* when they come before a
Vowel in a pure *Englifh* Word, they are to be
founded as in *chance*, *cheap*; and when they
com

ome after a Vowel, they are to be founded, as
n *ach*, *reach*, *rich*. But in Words derived
rom the *Greek* and *Hebrew*, they are to be
ounded like *k*, as in *character*, thefe few only
xcepted, *Rachel*, *Cherubin*, *Tychicus*, *Arch-
ifhop*, *Arch-Duke*, *Architect*, *Arch-enemy*,
Arch-pirat.

The Letters *gh*, in the beginning of a Word,
re to be founded like *g* hard, as in *ghaft*, *ghefs*,
n the middle of a Word, they are either not
ounded at all, or but foftly, as in *might*,
light, and in the end of a Word they have the
found of *ff*, as *cough*, *tough*.

Thefe Letters *th*, in Words of one Syllable
and in Words of more than one, ending in
ther, *thed*, *theth*, *theft*, *thing*, they have the
found of *d*, in other words the found of *t*, or
the Greek *Theta*.

The Letters *ph* never begin a pure *Englifh*
Word, but fuch only as are derived from the
Greek and *Hebrew*, as *Pharifee*, *Pharez*, *Epitaph*,
and in thefe they are founded like *f*.

The Liquids, *l, m, n, r*, when another Con-
fonant doth precede them in the beginning or
middle of a Word, do retain their own found,
but in the end of a Word, though the Vowel
ought to be written, yet in the pronunciation,
you muft ftop at the two Confonants, and omit
the Vowel; for Example, *fable*, *acre*, *uncle*,
muft be pronounced as though they were writ-
ten thus, *fabl*, *acr*, *uncl*.

CHAP.

CHAP. II.

Of Words.

A *Word*, is such a comprehension of Letters and Syllables, as helpeth Man-kind to express their minds to one another.

There are eight kinds of Words, or parts of Speech, *Noun, Pronoun, Verb, Participle, Adverb, Conjunction, Prepofition, Interjection.*

A *Noun*, is the name of a Perfon or Thing; as, an *Author*, a *Book*, *learned*, *guilded*.

Of *Nouns*, fome be *Subftantives*, and fome be *Adjectives*.

A *Noun Subftantive*, is a Word, that fignifieth fomething, and may have the fign (*a*) or (*the*) before it; as, *a Man, the Book*.

A *Noun Adjective*, is a Word, that cannot fignifie a thing of it felf; as, *good, bad*.

There are two forts of *Nouns Subftantives*.

A *Noun Subftantive* proper, and a *Noun fubftantive* common.

A *Noun fubftantive* proper, is a *Noun* that is proper to the perfon or thing, that it betokeneth; as, *Henry, England*.

A *Noun fubftantive* common, is a *Noun* common to all things of the fame kind; as, *a Man, a Land, an Angel*.

To a *Noun* there doth belong two things, number and comparifon.

There be two *Numbers*, the *fingular* and the *plural*; The *Singular number* fpeaketh but of

One,

One; as, a *Man*, a *Book*, a *Stone*. The *Plural number* fpeaketh of more than One; as, *Men*, *Books*, *Stones*.

Nouns fubftantive of the *fingular number*, are turned into the *plural*, by adding unto them *s* or *es*, as *web*, *webs*, *robe*, *robes*, *Church*, *Churches*, *hedg*, *hedges*. Some *Nouns* of the *fingular number* ending in *f*, being *plurals*, do change *f* into *v*, as *beef*, *beeves*, *calf*, *calves*. And fome are made *plurals*, by adding of *en* or *ren*; as, *Ox*, *oxen*, *chick*, *chicken*, *brother*, *brotheren*, or by contraction, *brethren*, *child*, *children*; of *Man* is formed *mannen*, or *men*, *houfe*, *houfen*, *hofe*, *hofen*; to which may be added, *moufe*, *mice*, *loufe*, *lice*, *die*, *dice*, *fow*, *fwine*, *cow*, *kine*, *penie*, *pence*, *goofe*, *geefe*, *tooth*, *teeth*, *foot*, *feet*; thefe two, *Sheep* and *Mile*, are both *fingular* and *plural*; as, *one fheep*, *ten fheep*, *one mile*, *ten mile* or *miles*.

Other variation of *Nouns* we have none in the *Englifh* Tongue; all other diftinctions are made by thefe Articles and Prepofitions; *a*, *of*, *to*, *the*, *o*, and *in* or, *from*, &c.

Nouns that fignifie the Male kind, we call *hees*; fuch as fignifie the Female, we call *fhees*; and of fuch as fignifie neither, we fay *it*; as, *Efau* could not obtain his Fathers Bleffing, though *he* fought *it*, with tears: *Jezabel* was a wicked Woman, for *fhe* flew the Lords Prophets.

Comparifon belongeth only to *Nouns Adjectives*, whofe fignification may be increafed, or diminifhed.

There be three degrees of *Comparifon*, the *Pofitive*, *Comparative*, and the *Superlative*.

The

The *Positive degree* setteth down the quality of a thing absolutely without excess, as *hard*, *soft*, *swift*.

The *Comparative degree* raiseth the signification of the *Positive* in comparison of some other, as *harder, softer, swifter*.

The *Superlative* exceedeth his *positive* in the highest degree, as *hardest, softest, swiftest*.

Adjectives are compared in the *English* tongue, either by the signs *more* and *most*, or by the terminations *er*, and *est*, as *hard, harder*, or *more hard, hardest*, or *most hard*.

Some *Adjectives* are compared irregularly; as, *Good, better, best; bad, worse, worst; little less, least*.

CHAP. III.

Of a Pronoun.

A *Pronoun* is a part of Speech, much like to a *Noun*, implying a Person, and not admitting the Sign *a* or *the*, before it.

There are twelves *Pronouns, I, Thou, He, who, which, that, the same, my, thy, this, his, whose*.

Of *Pronouns,* some be *primitives* and some *derivatives*.

Pronoun primatives are of three sorts, *Personal, Relative* and *Demonstrative*.

There are three *Pronoun personals, I, Thou,* and *He*.

Pronoun

Pronoun Relatives, are likewise three, *who*, *which* and *that*.

Pronoun Demonstratives, are these two, *this*, *the same*.

Pronoun Derivatives are these four, *my*, *thy*, *his*, *whose*.   All which with their variations, are expressed in the following Type.

Possessives.

1. Person. $\begin{cases} Sing. \begin{cases} \text{I, me, my, mine.} \end{cases} \\ Plur. \begin{cases} \text{we, us, our, ours.} \end{cases} \end{cases}$

2. Person. $\begin{cases} Sing. \begin{cases} \text{thou, thee, thy, thine.} \end{cases} \\ Plur. \begin{cases} \text{ye, you, your, yours.} \end{cases} \end{cases}$

3. Person. $\begin{cases} Sing. \begin{cases} Mal. \text{ he, him, his.} \\ Fem. \text{ she, her, hers.} \\ neith. \text{ it,} \qquad \text{its.} \end{cases} \\ Plur. \begin{cases} \text{they them, their, theirs.} \end{cases} \end{cases}$

Relatives. $\begin{cases} To\,pers. \begin{cases} \text{who, whom, whose.} \end{cases} \\ To\,thing. \begin{cases} \text{what,} \qquad \text{whereof.} \end{cases} \end{cases}$

Own is a *Noun adjective*, and *self* or *selves* a *Substantive*, but are sometimes joyned to, or compounded with the *Pronouns*; as, *my self*, *thy self*, *themselves*, *his own self*, *their own selves*.

This word *where*, with certain Prepositions following it; as, *about*, *at*, *by*, *in*, *of*, *unto*, *with*, hath the signification of *which as*, *wherein*, or *in which*.   And these words, *here*, *there*, are in like manner used for, *this*, *that*; as, *herewith*, *therewith*, for *with this*, *with that*.

<div align="right">CHAP.</div>

CHAP. IV.

Of a Verb and Participle.

A *Verb* is a part of Speech, that joyneth the Signification of other Words together.

There are three kinds of *Verbs*; *Active*, *Passive*, and *Neuter*.

A *Verb Active*, is a *Verb* that betokeneth doing, as *I love*.

A *Verb Passive*, is a *Verb* which betokeneth suffering, as *I am loved*.

A *Verb Neuter*, is a *Verb* which betokeneth being, as *I am*.

Four things belong to a *Verb*; *Mood*, *Tense*, *Number*, and *Person*.

There are four *Moods*, the *Indicative*, the *Imperative*, the *Potential*, and the *Infinitive*.

The *Indicative* either sheweth a reason true or false, as *I love*, or asketh a Question, as, *dost thou love?*

The *Imperative Mood*, intreateth, permitteth, or commandeth, as *love he*, or *let him love*.

The *Potential Mood*, signifieth a power, duty, or desire, and hath one of these Signs, *may*, *can*, *might*, *would*, *should*, *could*, or *ought*, as *I may or can love*.

The *Infinitive Mood*, notes no certain Number or Person, but followeth another *Verb*, or an *Adjective*, and hath commonly this Sign *(to)* before it, as *I desire to learn, worthy to be praised*.

The *Tenses* or distinctions of Time, are five,

The

The *Present Tense*, the *Preterimperfect Tense*, the *Preterperfect Tense*, the *Preterpluperfect Tense*, and the *Future Tense*.

These *Tenses* in respect of signification, are thus distinguished; in the *Indicative Mood*, *do* is the sign of the Present Tense, *did* of the Preterimperfect Tense, *have* of the Preterperfect, *had* of the Preterpluperfect, *shall* and *will* of the Future,

In the *Potential Mood*, by the signs already given, the Present Tense by the signs *may* or *can*, the Preterimperfect *would, should, could, or ought*, and the Preterperfect, by annexing the sign have to the former Signs, and the Future, by adding *hereafter* to the signs of *may* or *can*, the Signs of the Present; as, *I may or can hereafter*, the Preterpluperfect in this Mood is wanting in the *English* Tongue.

But in respect of Termination, there are no Moods but one, no Tenses but two, namely, the *Present*, and *Preterimperfect* Tenses.

And the Preterimperfect Tense is formed from the Present, by adding thereto the termination *(ed)* and in some few the termination *(en)* as of *love* is formed *loved*, of *fall, fallen.*

The Persons in every Tense are distinguished by the personal Pronouns, *I*, *Thou*, and *He*, in the Singular Number, and *We*, *Ye*, *They*, in the Plural; only the Second Person Singular in the Present and Preterimperfect Tenses is formed from the first, by adding thereto the Termination *est*, as of *love, lovest*, of *loved, lovedst*; and the Third Person Singular in the Present Tense

Tenfe is formed from the First, by adding thereto the Termination *(eth)* as of *love* is formed *loveth*, other variations of Perfons or Tenfe there is none, but what is done by Signs, as was faid before.

A *Verb Active* then is thus formed in the *Indicative Mood.*

Prefent Tenfe.

Sing. Love, loveft, loveth.   *Plur.* Love,
Infinitive, To love.

Preterimperfect Tenfe.

Sing. Loved, lovedft, loved.   *Plural.* Loved.

This *Verb Neuter*, *Am* or *Be* is thus formed.

In the *Prefent*   Am, art, is,   *Plur.* Are.
Tenfe.   Be, beeft, be,   *Plur.* Bee.

In the *Preterim-*   Was, waft, was,   *Plural.*
perfect Tenfe.   Were, wert, were,   Were.

Infinitive. To be.

A *Verb Paffive*, is the fame throughout all Moods and Tenfes, with a *Verb Neuter*, the *Preterimperfect Tenfe* of the Active Voice, being added thereunto; Thus the Paffive Voice of this Verb Active, *I love*, is formed, by adding *loved* to all the Tenfes and Perfons of this Verb Neuter, *I am.*

For Example.

The *Prefent Tenfe* of the *Indicative Mood* is thus formed,

I

I am loved , } { We
Thou art loved , } { Ye are loved ,
He is loved. } { They

A *Participle* is a part of Speech , derived of a Verb, from which it hath Signification , of Time present , past , or to come.

There are two *Participles* , one of the Active, and another of the Passive Voice.

The *Participle* of the Active Voice is derived from its Verb, by adding the Termination (*ing*) to the *Present Tense* ; as of *love*, *loving*.

The *Participle* of the Passive Voice is for the most part, the same with the *Preterimperfect Tense* of the Active ; as the *Participle* of the Passive Voice in this Verb *love* is *loved*.

From this General Rule many Verbs are Excepted , for of

Make		made	take, took, taken
lead		led	shake, shook, shaken
bereave		bereft	seeth, sod, sodden
smell		smelt	shear, shore, shorn
seek	Is formed	sought	rise, rose, risen
beseech		besought	give, gave, given
think		thought	strive, strove, striven
work		wrought	sing, sang, sung
buy		bought	know, knew, known
grinde		ground	throw, threw, thrown
stand		stood	go , went , gone ,

Of these, see more in my School Pastime.

CHAP.

CHAP. V.

Of Adverbs, Conjunctions, Prepositions, and Interjections.

AN *Adverb* is a Word joyned to a Verb or Noun, to declare their Signification.

Some of Time, as *when, now, then, to day.*
Some of Number, as, *how oft, once, twice.*
Some of Order, as, *first, next, afterward.*
Some of Place, as *where, here, there.*
Some of Affirming, as, *yea, perhaps.*
Some of Denying, as, *no, not.*
Some of Shewing, as, *lo, behold.*
Some of Similitude, as, *so, how much, more.*

A *Conjunction* is a part of Speech, which joyneth Words and Sentences together, of which these are some, *And, also, likewise, nor, neither, whether, or, either, but, for,* &c.

A *Preposition,* is a Word commonly set before other parts of Speech, either in apposition, as *before the Master,* or in composition, as *overwise.*

An *Interjection* is a Word, expressing some suddain passion of the Mind, *oh, alass, O strange, ho, hark, sirrah.*

CHAP. VI.

Of Dividing of Words into Syllables.

FOr the dividing of Words into Syllables there are four Rules.

1. Two Vowels which make no Dipthong, muſt be divided; as, *ie, iu, ua*; as in *qui-et*, *tri-umph*, *mutu-al*.

2. Thoſe Conſonants which are doubled in the middle of a Word, muſt be divided; as in *Abba, accord, adder.*

Except they be needleſly doubled, as in words of the *Plural Number*; as in *crabbs, rodds.*

Except ſuch words in which they are doubled for diſtinction ſake; as in the words, *Am, Cann, Inn.*

3. *Rule.* When a Conſonant cometh between two Vowels, it is to be joyned to the latter; as in *a-vail, a-ni-mate.*

But to this Rule there are four Exceptions.

1. Except Words ending in *es*, as in *Nouns* of the *Plural Number*, and *Verbs* of the *third perſon Singular*, in which this particle is for the moſt part ſwallowed up, in the former Syllable; but in all proper Names, except *Charles* and *James*, it makes a diſtinct Syllable.

2. Except Words that are compounded of ſuch Simple Words, as are ſignificant apart, in which each Simple Word muſt retain its own letters; as, *Tradeſ-man, ſafe-guard, henceforth.*

G   3. Ex.

3. Except *Derivative* Words, whose addition to the *Primitive*, doth signifie nothing of it self, in which the *Primitive* must be sounded by it self, and the addition by it self; as *hope-less*, *lov-ing*, *joyn-ing*, and such like.

4. Except such Words in which *x* comes between two Vowels, in which it must be joyned to the first Vowel; as, *ox-en*, *ex-ercise*.

4. *Rule.* Any two or three Consonants, which may be joyned together in the beginning of a Word, are not to be separated in the middle; as in *a-gree*, *be-stow*, *en-thrall*, *de-struction*: but in compounded Words, each simple Word must retain its own Letters.

When you are to write any hard long Word, mark how many founds or Syllables it hath, as if you were to write *disdainfullness*, *universalitie*, or the like, before you write it, say thus to your self; *dis-dain-full-ness*, *u-ni-ver-sa-li-tie*, and you shall hardly miss in the writing thereof.

CHAP. VII.

Of Sentences, and such Distinctions, or Points as are to be used in writing, and observed in Reading.

A *Sentence*, is a number of Words, joyned together in perfect Sense.

The Stops or Points to be observed in *Senten-*

ces, are of two sorts, *Primary*, and *Secondary*.
The *Primary* Points are these Eight.

1. A *Comma*, made with a little stroke thus (,)

2. A *Colon*, made with two points thus (:)

3. A *Semi-colon*, made with a point, and a little stroke under it thus (;)

4. A *Period*, made with a single point thus (.)

5. An *Erotesis* or *Interrogation*, made in this manner (?)

6. An *Ecphonesis*, or note of *Admiration*, whose note is a perpendicular right line, with a point under it thus (!)

7. A *Parenthesis*, is a note, like two half Moons, inclosing a Sentence, which may be used or omitted, and yet the sense remain intire, thus ()

8. A *Paracthesis*, is a note, which doth include a Word which is opposed to another Word, and is made with two *Semiquadrates*, thus []

The *Secondary* Points are these Six.

1. An *Apostrophe*, which is a note, set on the top or side of a Letter, whereby two Syllables are contracted into one, and is made like a *Comma*, thus (') as *it's* for *it is*.

2. An *Eclipsis*, which is a note cutting off one or more Words in the beginning or ending of a Verse or Sentence, cited in our Writing, and is made with a long stroke thus —— as

—— *Princes*

——————— Princes are not wise,
Who sleep themselves, and trust their servants Eyes.

3. A *Dieresis*, which is a note for the parting of two Vowels, which otherwise might seem to make a *Diphthong*, and is made with two pricks over the two Vowells, thus, (¨) as in *Lais*.

4. An *Hyphen*, which is a note of continuation, made thus (-) and is to be used when one part of a word concludeth the former line, and the other part beginneth the next; or else, when two words are, by way of Elegancy, as it were joyned into one; as *self-love*, for the love of ones self.

5. An *Accent* which is a small stroak drawn slopewise towards the left-hand, thus, (´) and is to be set over that Syllable in a Word, which is to be pronounced long.

6. A *Circumflex*, which is the joyning together of two oblique stroaks into one figure, one of them being made towards the right hand, and the other towards the left, and is to be set over a Vowel, thus, (â) which is to be pronounced long, as in *bîte, wîle, stîle*, not in *bit, will, still*.

The *Accent* in Words of many Syllables is commonly placed on the third Vowel from the last; as in *tolerátion, índustry*.

But Words ending in (*ary*) have the accent on the first Syllable; as *témporary*; Words that have many Consonants in the last Syllable save one, have their accent on that Syllable, as in *etérnal*;

etérnal; Words ending in *ire* and *ure*, have their accent in that Syllable; as *inúre*.

A *Noun* hath its accent in the firſt, a *Verb* in the laſt Syllable; as *ábſent*, to *abſént*.

So *Húmane*, when it comes before a *Subſtantive*, as *húmane-learning*; but in the laſt Syllable, when it comes after a *Subſtantive*, as *Chriſt had two natures*, the one *divìne*, the other *humàne*.

C 3 THE

... ; Words ending in *ive* and *ure*, have their accent in that Syllable; as *in*...

A *Noun* hath its accent in the first, a *Verb* in the last Syllable; as *Abject*, to *Abject*.

So *Woman*, when it comes before a Substantive, ... *Fashion-learning*; but in the last Sylla-ble when it comes after a Substantive, as *Chaff*... had *two answers*; the one *double*, the other ...

THE ENGLISH ACADEMY.

The SECOND PART.

Of ARITHMETICK.

CHAP. I.

Of Single Arithmetick in whole Numbers.

ARithmetick is the art of accompting by Numbers; it is either *positive* or *negative.*

2. *Positive Arithmetick*, is that which is wrought by certain and infallible Numbers at first propounded; and this is either *single* or *comparative.*

3. *Single*, which is wrought by Numbers, considered alone, without relation to one another, and this either in whole Numbers, or in Fractions.

4. The

4. The parts of *single Arithmetick*, are two, *Notation* and *Numeration*.

5. *Notation* hath two parts; the first sheweth the value of the Notes, by which all Numbers are expressed; the second sheweth how to read the Numbers which are expressed by those Notes.

6. The Notes or Characters, by which all Numbers are usually expressed are these, 1. *one* 2. *two*, 3. *three*, 4. *four*, 5. *five*, 6. *six*, 7. *seven*, 8. *eight*, 9. *nine*, 0. *nothing*.

7. These Notes are either significant Figures, or a Cypher.

8. The significant Figures, are the first nine, *viz.* 1, 2, 3, 4, 5, 6, 7, 8, 9. The first whereof is more particularly termed an *unite* or *unitie*, the rest are said to be composed of *unities*; so 2, is composed of two *unites*; 3, of three *unites*, &c.

9. The *Cypher*, though it signifie nothing of it self, yet being set before or after any of the rest, increaseth or decreaseth their value, as shall be further shewed hereafter.

10. The second part of *Notation*, is the reading of the Number expressed by these Notes; and this is done by distinguishing the Number given into Degrees and Periods.

11. The Degrees are three, the first is that first place of a Number towards the right hand, and is the place of Unity. The second is the second Figure towards the right hand, and this is the place of Tens. The third is the third Figure towards the right hand, and is the place

place of Hundreds; so this Character 9, doth signifie Nine; these Notes 27, Twenty seven; and these 235, Two hundred thirty five.

12. A *Period*, is when a number consisting of more Notes than three, hath each three Notes thereof (beginning at the right hand) distinguished by Points or Commas : The several parts of the Numbers so distinguished, are called *Periods*; so the Number 38156249, being distinguished into *Periods*, will stand thus, 38.156.249. of which the first Period is read thus, Two hundred forty nine; the first Figure in the second Period is the place of Thousands, the second Tens of Thousands, and the third Hundreds of Thousands. In the third Period, the Figure is in the place of Millions, the second Tens of Millions, and so this Number is thus to be read. Thirty Eight Millions, One Hundred Fifty Six Thousand, Two Hundred Forty Nine.

13. *Numeration*, is that which by certain known Numbers propounded, doth discover another Number unknown.

14. *Numeration* hath four Species, *Addition*, *Subtraction*, *Multiplication*, and *Division*.

15. *Addition*, is that by which divers Numbers are added together, to the end that the Sum or Total may be discovered. For which purpose, having placed the Numbers as in the following Example, begin with those in the Unity place first, then with these in the place of Tens, then of Hundreds, and so forward, according as the Numbers given do consist

fift of places, carrying the Tens, if there be
any, to the place of the next greater rank, as
here you fee.

```
    472961          3814527
    341608          4567890
     74325          6549238
      6739           816365
    ──────          ────────
    895633         15748020
```

16. *Subtraction* is that, by which one Num-
ber is taken out of another, fo that the Refi-
due or remainder may be known. To perform
this, you muft rank your Numbers, and begin
as in *Addition*; and in cafe any of the Figures
of the Number to be Subtracted fhall be greater
than that, from whence the Subtraction is to be
made, you muft borrow one from the next
place above it; as in the Examples following.

```
    895633          6549238
    341695          3814527
    ──────          ────────
    553938          2734711
```

17. *Multiplication*, is that by which we Mul-
tiply two Numbers, the one by the other, to
the end, that their Product may be discovered.

18. *Multiplication* hath three Parts, the
Multiplicand, the *Multiplicator*, and the *Pro-
duct*.

19. *Multiplication*, is Single or Compound.

20. Single *Multiplication*, is when the Mul-
                                    tiplicand,

...plicand, and Multiplicator, do each of them
consist of one only Figure; as if 9 were given
to be Multiplied by 6, 9 is the Multiplicand,
6 is the Multiplicator, and 54 is the Product.

21. Compound *Multiplication*, is when the
Multiplicator and Multiplicand do either, or
both consist of more Figures than one.

22. When the Product of any of the parti-
ticular Figures shall exceed ten, place the Ex-
cels under the Line, and for every ten that it
so exceeds, keep in mind one to be added to
the next rank: *Example*; 76147, being to
be Multiplyed by 5, the Product
is 180735, and 39634 being gi-
ven to be Multiplyed by 47, the
work will stand as in the Mar-
gin, where the Product by 7
is 277438, and the Product
thereof by 40 is 1585360, and
the Sum of these two Products
is 1862798.

$$
\begin{array}{r}
39634 \\
47 \\
\hline
277438 \\
158536 \\
\hline
1862798 \\
\hline
\end{array}
$$

23. *Division* is that by which we discover
how often one Number is contained in another,
that we may find out the Quotient.

24. *Division* hath three Parts, the *Dividend*,
the *Divisor*, and the *Quotient*; thus, if 35 were
given to be Divided by 5, 35 is the Dividend,
5 the Divisor, and 7 will be found to be the
Quotient.

25. In *Division*, make a crooked line at each
end of your Dividend, that on the left hand
serving for your Divisor, and that on the right
for

for the Quotient; then see how oft your Divi er
sor is contained in the first Figure or Figures o ur
your Dividend, and put the answer in the Qu ow
tient; then Multiply your Divisor by the fi he
gure in the Quotient, and the Product Su d
tract from your Dividend, then draw do ore
the next Figure of your Dividend, and a f
how oft your Divisor may be found in the re
mainer so increased, and the answer put in the
Quotient, and proved as before, till there b an
no Figures left in your Dividend, and so o
as the Question is repeated, so many place n
must be in the Quotient, as is manifest by th h
following Example.

1	047	) 1862798 (39634
2	094	141
3	141	452
4	188	423
5	235	297
6	282	282
7	329	159
8	376	141
9	423	188
		188
		0

Let 1862798, be given to be divided by 47,
I ask how often 47 may be had in 186? the
Answer is 3, which I place in the Quotient,
then I Multiply 47 by 3, the Product is 141,
which being Subtracted from 186, the Remai-
ner

...er is 45, to which draw down 2 the next Fi-
gure in the Dividend, and then it will be 452,
now then I ask how often 47 may be had in 452?
the which by the Table made by the continual
Addition of 47 unto it self, is 9 times, there-
fore I place 9 in the Quotient, and the Product
of 47 is 423, which being Subtracted from
452, the Remainer is 29, to which I draw 7
the next Figure, and then proceed as before,
and so at last I find the Quotient to be 39634.

26. *Multiplication* and *Division*, prove one
another, for if you Multiply the Quotient by
the Divisor, the Product will be equal to the
Dividend: so 39634, being Multiplied by 47,
the Product is 1862798, and this Product be-
ing Divided by 47, the Quotient is 39634.

CHAP.

CHAP. II.

Of Single Arithmetick in Fractions.

Single Arithmetick in whole Numbers, hath been shewed in the last Chapter; Single Arithmetick in Fractions now followeth.

2. A Fraction is a part of an Integer.

3. Single Arithmetick in Fractions, doth also consist of two Parts, Notation, and Numeration.

4. Notation of Fractions, is that which sheweth how the Fraction part of any Integer may be expressed in numbers; that is, an Integer on one whole thing being Divided into any Number of equal parts, Notation sheweth how these parts may be expressed; as if a Yard were Divided into four parts, and it were desired, that I should set down three of these parts; the usual manner is thus, draw a line, and set the Number of parts into which the Integer is supposed to be Divided, under the line, and the number of parts you would express set above the line; thus to express three of four parts, I write 4 under a line, and 3 above it, thus, $\frac{3}{4}$; and so may you do with any other number propounded: Where note, that the number above the line is called the Numerator, and the number under the line the Denominator.

5. A Fraction is either Proper or Improper.

6. A Proper Fraction is that whose Numera-

tor

℔ A Pound *Troy*, is —— 12 Ounces.
℥ An Ounce, is —— 8 Drams.
ʒ A Dram, is —— 3 Scruples.
℈ A Scruple, is —— 20 Grains.

14. Besides *Troy* Weight, there is another kind of Weight used in *England*, called *Avordupois* Weight, a Pound whereof is equal to fourteen Ounces, twelve peny Weight *Troy*, the which is subdivided into 16 Ounces, each Ounce into 16 Drams, and each Dram into 4 Quarters. Of this Weight 112 makes a Hundred.

15. The Measures used in *England* are of Capacity or Length.

16. The Measures of Capacity are liquid or dry; Liquid Measures are according to this Table.

One pound of Wheat *Troy* Weight —— }	One Pint.
Two Pints	One Quart.
Two Quarts	One pottle.
Two Pottles	One Gallon.
Eight Gallons	One Firkin of Ale.
Nine Gallons	One Firkin of Bear.
Two Firkins	One Kilderkin.
Two Kilderkins	One Barrel.
Forty two Gallons	One Tearce of wine
Sixty three Gallons	One Hogshead.
Two Hogsheads	One Pipe or Butt.
Two Pipes	One Tun.

17.

17. Dry Meafures are thofe in which all kind of dry fubftances are Meted; as Grain, Sea-coal, Salt, and the like; their Table is this that followeth.

	Makes	
One Pint		One Pint.
Two Pints		One Quart.
Two Quarts		One Pottle.
Two Pottles		One Gallon.
Two Gallons		One Peck.
Four Pecks		1 Bufhel land meafure.
Five Pecks		1 Bufhel water meafure.
Eight Bufhels		One Quarter.
Four Quarters		One Chaldron.
Five Quarters		One Wey.

18. Long Meafures are expreffed in the Table following.

	Make	
Three Barley-Corns in length		One Inch.
Twelve Inches		One Foot.
Three Foot		One Yard.
Three Foot 9 Inches		One Ell.
Six Foot		One Fathom.
Five yards and an half		One pole or pearch.
Forty Poles		One Furlong.
Eight Furlongs		One *Englifh* Mile.

Note that a Yard, as alfo an Ell is ufually fub-
D   divided

divided into Four Quarters, and each Quarter into four Nails.

19. A Table of Time is this that followeth.

Sixty Minutes		One Hour.
Twenty four Hours	Make	One Day natural.
Seven Dayes		One Week.
Four Weeks		1 month of 28 dayes

Fifty two Weeks, One Day, and Six Hours make One Year.

And these Fractions of Money, Weight, Measure, &c. are usually written under their several Denominations, instead of having their Denominators written under them thus;

lib.	shill.	pence.	farth.
23.	19.	08.	3.

And as their Notation is two fold, so is their Numeration also; First, then I will shew you the Numeration of parts when written, as Integers, and then as vulgar Fractions.

20. Numeration of parts when written, as Integers, is Accidental or Essential.

21. *Accidental Numeration*, otherwise called *Reduction*, is either Descending or Ascending.

22. *Reduction Descending*, is when a Number of greater Denomination being given, is required, to find how many of a lesser Denomination, are equal in value to that given Number

Number of the greater. And this is perfor-
med by *Multiplication*; as if it were required
to Reduce 329 Shillings into Pence, if you
Multiply 329 by 20, the number of Shillings
in a Pound, the Product will be 6580 Shillings,
and 6580 shillings being Multiplied by 12, the
number of Pence in a Shilling, the Product
will be 78960 Pence.

23. *Reduction Afcending*, is when a Number
of a leffer Denomination being given, it is re-
quired, to find how many of a greater Deno.
mination, are equal to that given Number of
the leffer: And this is done by *Divifion*; as if
it were required to find how many Pounds there
were in 78960 Pence; if 78960 Pence be
Divided by 12, the Number of Pence in a
Shilling, the Quotient will be 6580 Shillings,
and if 6580 Shillings be Divided by 20, the
Number of Shillings in a Pound, the Quotient
will be 329 Pounds, and fo for any other.

24. *Effential Numeration*, doth confift
of four Species, *Addition*, *Subtraction*, *Mul-
tiplication*, *and Divifion*.

25. In *Addition* of Numbers of feveral De-
nominations, you muft begin with the leaft firft,
and when the fum of any of the Denominati-
ons amounts to an Integer, add it to the next
Denomination that is greater.

Example.

Example.

23	:	14	:	10	:	1	15 : 18 : 10
16	:	15	:	09	:	2	16 : 17 : 09
27	:	09	:	11	:	1	17 : 16 : 08
44	:	19	:	07	:	3	18 : 15 : 07

113 : 00 : 02 : 3   69 : 08 : 10

26. In *Subtraction* of Numbers of several
Denominations, when any of the parts of the
greater Number are less than the parts of the
lesser Number subscribed, Deduct the parts of
the lesser Number from the parts of the greater
increased with an Integer, of the next superiour
our Denomination, and keeping one in mind,
add to the next place of the Number given to
be Subtracted.

Example.

44 : 13 : 07 : 1   69 : 08 : 07
25 : 19 : 11 : 3   42 : 19 : 11

18 : 13 : 07 : 2   26 : 08 : 08

27. In *Multiplication* of Numbers of several
Denominations, you must first reduce the
Numbers given to their least Denominations,
and then Multiply them as hath been shewed
in whole Numbers, the Product Divided by
the Square of the parts of an Integer, reduced

to

the laſt Denomination, ſhall in the Quo-
tent give the Product required.

Example.

Let the Product of 17 *l*. 19 *s*. 6 *d*. by
l. 13 *s*. 6 *d*. be required. 17 *l*. 19 *s*. 6 *d*.
eing reduced to make 4314 *Pence*. And
l. 13 *s*. 6 *d*. reduced do make 1362 *Pence*.

The Multiplicand.	4314
The Multiplicator.	1362
	8628
	25882
	12942
	4314
The Product.	5875668

The Number of Pence in a Pound are 240,
nd the Square thereof is 57600, by which
Dividing 5875668 the Quotient; 102 *lib.*
0 *ſhill.* 01 *peny.* 3 *farthings*, and $\frac{4428}{5760}$ is the
Quotient ſought.

28. In *Diviſion* of Numbers of ſeveral De-
ominations, firſt reduce your Diviſor to its
Number of parts in the leaſt Denomination,
hen Multiply your Dividend, by the Square
f the parts in an Integer reduced to the leaſt
Denomination; and if there be any parts an-
exed, to the Integers of the Dividend, they
muſt be reduced to the higheſt Fraction, that

the Square of the parts in an Integer reduced
to its leaſt Denomination will bear, and added
to the former Product, the whole being divided by your Diviſor reduced, will give you
the Quotient ſought.

Example.

Let 102 : 00 : 01 : 3 $\frac{4421}{1760}$ be given to be
Divided by 5 : 13 : 6. Firſt I reduce the Diviſor given to its Number of parts in the leaſt
Denomination, and it makes 1362 Pence
then I Multiply 102 the Integral part of my
Dividend, by 57600, the ſquare of Pence in
a Pound, the Product is 58752, and the Fraction of my Dividend 00 : 01 : 3 $\frac{4421}{1760}$ being
reduced, is $\frac{421}{57600}$, which being added to the
former Product 58752, the Sum is 5875668
for the Dividend; which being divided by
1362, the Quotient is 4314 *pence*, that is
17 *lib.* 19 *ſhill.* 6 *pence.*

29. *Numeration* of Fractions, when written
with their Numerators and Denominators, is
alſo Accidental and Eſſential.

30. *Accidental Numeration,* otherwiſe called *Reduction,* is three-fold.

1. To Reduce one Fraction which is not already in its leaſt terms, to a leſſer Denomination.

To do this, divide the Numerator and Denominator by their greateſt common meaſure
the two Quotients ſhall be one of them, a new
Numerator, and the other a new Denominator

D 3 the

f a Fraction equal to the Fraction given, and
its leaft terms.

Example $\frac{91}{117}$ being given to be Reduced,
he greateft common meafure is 13, by which
Dividing 91, the Quotient is 7, for a new
Numerator, and Dividing 117 by 13, the
Quotient is 9 for a new Denominator, and fo
$\frac{91}{117}$ is reduced to $\frac{7}{9}$.

The greateft common meafure between two
Numbers is found thus; Divide the greater
Number by the lefs, and your Divifor by the
Remainer, if there be any, your laft Divifor
s the common meafure fought, as in the fol-
owing Example.

$$91) 117 (1$$
$$91$$
$$26) 91 (3$$
$$78$$
$$13) 26 (2$$
$$26$$
$$0$$

2. To Reduce many Fractions of divers De-
nominations into one Denomination.

To do this, Multiply each Numerator by all
the Denominators except its own, the Products
fhall be the new Numerators, then Multiply
all the Denominators together, and the Pro-
duct fhall be the common Denominator fought.

D 4   *Ex-*

Example. $\frac{2}{3}$ $\frac{4}{5}$ $\frac{6}{7}$ will be reduced to $\frac{?}{10}$ $\frac{?4}{105}$ $\frac{?0}{105}$.

3. To Reduce any Fraction from one Denomination, to any other Denomination desired. And to do this Multiply the Numerator given, by the Denominator required, and Divide the Product by the Denominator given, the Quotient shall be the Numerator desired.

Example, let it be desired to Reduce $\frac{17}{20}$ to a Fraction, whose Denominator shall be 100, first Multiply 17 by 100, the Product is 1700, which being Divided by 20, the Quotient is 85, for the new Numerator desired.

31. Essential Numeration of Fractions hath four Species, *Addition*, *Subduction*, *Multiplication* and *Division*.

32. In Addition of Fractions, the Fractions given must be first Reduced to one Denomination, and then add the Numerators together, so have you the Sum of the Fractions, so $\frac{4}{9}$ and $\frac{3}{9}$ make $\frac{7}{9}$.

33. Subtraction of Fractions is thus, if of one Denomination, Deduct the less from the greater, their difference is the remainer, so $\frac{2}{9}$ taken from $\frac{7}{9}$ rest $\frac{5}{9}$.

34. Multiplication of Fractions, is thus, Multiply all the Numerators together, so is their Product a new Numerator, then Multiply all the Denominators together, and their Product is a new Denominator.

Thus if $\frac{7}{12}$ and $\frac{4}{8}$ were to be Multiplied, the Product will be $\frac{28}{96}$.

35. Division of Fractions is thus, Multiply the

he Numerator of the Dividend by the Denominator of the Divisor, the Product shall be a new Numerator; also Multiply the Numerator of the Divisor, by the Denominator of the Dividend, so shall the Product be a new Denominator, and this new Fraction is the Quotient sought; so if $\frac{4}{9}$ were to be Divided by $\frac{1}{3}$, the Product will be $\frac{12}{17}$.

36. When the Denominator of a Fraction is an Unite with Cyphers, the Fraction is more particularly called a Decimal; and such Fractions may be expressed without their Denominators as well as with them, thus, $\frac{5}{10}$ may be written thus, .5.

37. When the Numerator doth not consist of so many Places, as the Denominator hath Cyphers, fill up the void places of the Numerator with Cyphers, so, $\frac{5}{100}$, $\frac{25}{1000}$, are written thus, .05, and .025.

38. Numeration of Decimal Fractions, is likewise two fold, Accidental and Essential.

39. Accidental Numeration, otherwise called Reduction, is performed, by the third way of Reduction, shewed in the Twenty seventh Rule of this Chapter.

40. Essential Numeration, hath in it the four usual Species, *Addition, Subtraction, Multiplication*, and *Division*.

41. Addition of Decimals is the same with Addition of whole Numbers, if a point or line be set between the Integers and the Parts, as in the following Examples.

2.00741

$$
\begin{array}{r}
2.00741 \\
.74258 \\
.96314 \\
\hline
3.71313
\end{array}
\qquad
\begin{array}{r}
23.05678 \\
16.14365 \\
32.76108 \\
\hline
71.96151
\end{array}
$$

42. Subduction of Decimals doth differ from Subduction in whole Numbers, but by a point to diftinguifh the whole Number from the broken; as in the Example following.

$$
\begin{array}{r}
25.07495 \\
17.89637 \\
\hline
7.17859
\end{array}
\qquad
\begin{array}{r}
36.01436 \\
17.83589 \\
\hline
18.17847
\end{array}
$$

43. Multiplication of Decimal Fractions, is the fame with Multiplication in whole Numbers, but when the work is finifhed, to diftinguifh the Integers from the Decimals, do thus; fo many places of parts as are in both the numbers given, being feparated by a point, the reft of the Figures towards the left hand are Integers, and thofe towards the right are Decimal parts; as in thefe Examples.

$$
\begin{array}{r}
12.45 \\
7.08 \\
\hline
9960 \\
87150 \\
\hline
88.1460
\end{array}
\qquad
\begin{array}{r}
17.37 \\
3.72 \\
\hline
3474 \\
12159 \\
5211 \\
\hline
64.6164
\end{array}
$$

44

44. Division of Decimal Fractions is the same with Division in whole numbers, but when the Work is finished, to distinguish the Fractional part from the Integers, observe this general Rule.

The first Figure in your Quotient will be alwayes of the same degree or place with that Figure or Cypher in your Dividend, which standeth over the Unites place in your Divisor.

For Example: 78925, being given to be divided by 32, the Quotient will be 2466, and because the place of Unites in the Divisor, doth stand under the place of seconds in the Dividend, therefore the first Figure in the Quotient, will be in the place of seconds, and the first must be supplied with a Cypher, and then the Quotient will be 0.02466.

CHAP.

CHAP. III.

Of Comparative Arithmetick.

THus much hath been said concerning Single Arithmetick, Comparative follows, which is wrought by Numbers, as they are considered to have relation to one another.

2. This Relation consists either in Quantity or in Quality.

3. Relation in Quantity is the reference that the Numbers themselves have one to another; as when the Comparison is made between 8 and 2, or 2 and 8; 7 and 3, or 3 and 7.

And here the Numbers propounded are alwayes two, whereof the first is called the Antecedent, the other the Consequent.

4. Relation in Quantity, consists either in the difference, or in the rate or reason found between the Numbers propounded; the one is found by Subtracting the less from the greater; so 6 is the difference between 8 and 2; but the other, to wit, the rate or reason, is found by Dividing the greater by the less, and thus the rate between 8 and 2 is four-fold, because 2 is found four times in 8; Or the rate may be also found by Dividing the less by the greater, or setting the Numbers given in manner of a Fraction, and thus the rate between 2 and 8 is 4 also, or $\frac{2}{8}$ that is $\frac{1}{4}$.

5. This rate or reason of Numbers is either Equal or unequal; Equal reason, is the relation that

that Equal Numbers have one to another, as 5
to 5, 6 to 6. Unequal Reason is the relation
that Unequal Numbers have one to another,
and this is either of the greater to the less, or
of the less unto the greater.

In the one the greater Number is the Ante-
cedent, and the less the Consequent; and in
the other the lesser Number is the Antecedent,
and the greater is the Consequent.

6. Relation in Quality, (otherwise called
Proportion) is the reference or respect that
the reasons of Numbers have one to another,
and therefore the numbers must be more than
two, or else there cannot be the comparing of
reasons in the Plural Number.

7. Proportion is two fold, Arithmetical
and Geometrical.

8. Arithmetical proportion, is when Num-
bers differ according to equal reason; that is,
have equal differences; as, 2, 4, 6, 8, 10, or 3,
6, 9, 12, in the first rank the common diffe-
rence is 2, and in the second 3.

9. Arithmetical proportion, is either con-
tinued, or interrupted.

10. Arithmetical proportion continued, is
when divers numbers are linked together by a
continued Progression of equal difference :
and in such a Progression, the sum of the first
and last Terms being Multiplied by half the
number of the Terms, the Product will be the
sum of all the Terms ; as in this Progression,
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, the sum
of the first and last is 13, which being Multi-
plied

plied by 6, half the number of the Term the Product is 78, the sum of all the terms that Progression.

11. Three Numbers being given in Arithmetical proportion, the Mean number being doubled is equal to the sum of the Extreams; 3, 6, 9, being given, the double of 6, the mean number is equal to the sum of 3 and 9 the two Extreams.

12. Arithmetical Proportion Interrupted, is when the Progression is discontinued, as these numbers, 2, 4, 8, 10.

13. In Arithmetical Proportion continued or discontinued, the sum of the Means is equal to the sum of the Extreams, as in 3, 6, 9, 12 being given, the sum of 6 and 9 is equal to the sum of 3 and 12; or 3, 6, 12, 15, being given, the sum of 6 and 12, is equal to the sum of 3 and 15.

14. Geometrical Proportion is, when divers numbers differ by the like reason; as, 1, 2, 4, 8, 16, which differ one from another by double reason; for as 1 is the half of 2, so 2 is the half of 4, 4 of 8, 8 of 16.

15. Geometrical proportion is either continued or interrupted, Geometrical proportion continued, is when divers numbers are linked together, by a continued Progression of the like reason; as, 1, 2, 4, 8, 16, or 3, 6, 12, 24, 48.

16. In Numbers Geometrically proportional, If you Multiply the last Term by the common rate by which they differ, and from the Product

duct Deduct the first Term, and Divide the Remainer by the former rate less by an Unite, the Quotient shall be the sum of all the Progressions; So 2, 6, 18, 54, 162, 486, 1458, being propounded the last Term 1460, being multiplied by 3 the rate, the Product is 4374 out of which deducting 2 the first Term, the Remainer is 4372, which being Divided by 2 the rate less one, the Quotient 2186 is the sum of that Progression.

17. Three Proportionals being given, the Square of the Mean is equal to the Product of the Extreams; so 4, 8, 16, being given, the Square of 8 is equal to four times $16. = 64$.

18. Geometrical Proportion interrupted, is when the Progression of like reason is discontinued; as, 2, 4, 16, 32, where the Term between 4 and 16 is wanting, and therefore the rate between 4 and 16 is not the same that is between 2 and 4, or 16 and 32.

19. Four Proportional Numbers whatsoever being given, the Product of the two Means is equal to the Product of the two Extreams; so 2, 4, 16, 32, being propounded, 4 times 16 is equal to 2 times 32, which is 64.

CHAP.

CHAP. IV.

Of the Rule of Proportion, or
Rule of Three.

FRom the laſt Rule of the former Chap.
ariſeth that precious Gem in Arithmetic
the *Rule of three*, which for its excellency
deſerves the name that is given to it, *T*
Golden Rule.

2. *The Golden Rule*, is that by which cert
numbers being given, another number Ge
metrically proportional to them may be fou
out.

3. The *Golden Rule* is either Single or Co
pound.

4. The Single Rule, is when three terms
numbers are propounded, and a fourth in pr
portion to them is deſired.

5. The Terms of the Rule of Three conſi
of two Denominations; two of the Ter
propounded have one Denomination, the thi
propounded and fourth required, have anothe

6. Of thoſe two numbers given which are
one Denomination, that which moves the Que
ſtion muſt poſſeſs the third place, the othe
number of the ſame Denomination, muſt be p
in the firſt place, and conſequently, the othe
known Term, which is of the ſame Denomina
tion with the fourth required, muſt poſſeſs th
ſecond place.

7. The three Terms propounded being thu
placed

placed, confider whether your third doth re-
quire more or lefs; if it requires more, Mul-
tiply the middle number by the greater of the
two Extreams, and Divide the Product by the
leffer, the Quotient is the fourth Number or
Term defired.

But if the third Term in the Queftion re-
quire lefs, Multiply the middle Term by the
leffer of the two Extreams, and the Product
Divide by the greater, the Quotient fhall be
the fourth Term defired; An Example in each
Cafe will fufficiently explain the Rule.

If 7 Pound of Sugar coft 2 s. 7 d. What
fhall 28 Pound of Sugar coft? The Terms muft
ftand thus,

℔ Sugar.	s.	d.	℔ Sugar	s.	d.
7 :	2 —	7 ::	28 :	10	4 .

Where it is plain, that 28 pound of Sugar
muft needs coft more than 7, therefore I Mul-
tiply 2 s. 7 d. or 31 pence, by 28, the Pro-
duct 868 being Divided by 7 and the Quotient
is 124 d. or 10 s. 4 d.

2. *Example*: If 7 Men will digg a Garden
in 31 Dayes, In how many Dayes will 28 Men
digg the fame Garden? Here the Terms muft
ftand thus,

Men.	*Dayes.*	*Men.*
7	31	28

And by the state of the Question it plain appears, that the third Term requireth less; therefore I Multiply 3 1, the middle Term, b 7, the lesser Extream, and the Product 21 being Divided by 28, the Quotient 7 $\frac{14}{28}$ is the fourth Term desired.

CHAP. V.

Of the Compound Rule of Three.

THe *Compound Rule of Three*, is when more than three Terms are propounded.

2. Under the *Compound Rule of Three* is comprehended the *Double Rule of Three*, and divers Rules of plural proportion.

3. The *Double Rule of Three*, is when five Terms are propounded, and a sixth in proportion to them is required.

4. In this Rule the five Terms given do consist of two parts; first a Supposition, and then a Demand : the Supposition is expressed by three of the Terms propounded, and the demand by the other two.

5. And here the greatest difficulty is in placing of the Terms; for which observe amongst the Terms of Supposition, which of them hath the same Denomination with the Term required, reserve that for the second place, and write

rite the other two Terms in the Suppofition
e above another in the firft place ; and laftly,
e Terms of Demand one above another , like-
ife in the third place , in fuch fort, that the
permoft may have the fame Denomination
ith the uppermoft of thofe in the firft place.

Example.

If 6 Clerks can write 45 fheets of Paper in 5
ayes ; How many Clerks can write 300 fheets
72 Dayes ? Here the Queftion is concerning
e number of Clerks, the 6 Clerks muft
erefore poffefs the fecond place, and the
ayes and Paper in the Suppofition muft be fet
the firft, one over the other, of which, if
aper be the uppermoft in the other Terms, the
aper muft be fet over the Dayes in the third
ace, and then the Number in the Queftion
ill ftand thus,

$$45 \longrightarrow 6 \longrightarrow 300$$
$$5 \qquad\qquad 13$$

6. The Terms propounded being thus placed,
e Queftion may be refolved by two Single
ules of Three, in this manner.

1. As the uppermoft Term of the firft place
to the middle, fo is the uppermoft Term in
e laft place to a fourth Number.

2. As the lower Term of the firft place is to
hat fourth Number, fo is the lower Term of
he laft place to the Term required.

But in both thefe Proportions, confidera-

ticn

tion must be had to the Term required, name-
ly, whether it must be more or less than the
middle Term given.

In our present Question, the fourth Term
in the first Proportion must be greater than the
second; for it is plain, that more work will re-
quire more men; therefore I say,

as 45 . 6 :: 300 . 40 Clerks.

But in the second Proportion, it is likewise
plain, that the more Time is given, the fewer
Persons are required; and therefore in this Pro-
portion, 5. 40. 13. I multiply the middle
Term by the first, and the Product 200 I divide
by 13, the last, and the Quotient is 15 $\frac{15}{13}$.

2. *Example:* If 100 *l*. gain 6 *l*. in 12 months.
What shall 276 *l*. gain in 18 months? In this
Question the Terms must be thus placed.

$$100 \text{——} 6 \text{——} 276$$
$$12 \qquad\qquad\qquad 18$$

1.   100 . 6 :: 276 . 16 . 56.

2.   12 . 16 , 56 :: 18 . 24 . 84.

CHA

CHAP. VI.

Of the Rule of Fellowship.

THe Rules of Plural proportion are those, by which we Resolve Questions that are discoverable by more Rules of Three than one, and cannot be performed by the Double Rule of Three mentioned in the last Chapter.

Of these Rules there are divers kinds and varieties, according to the nature of the Question propounded; I will only mention one, and refer the rest to my larger Treatise of this subject.

2. The Rule of Plural proportion that I mean to mention, is the Rule of *Fellowship*.

3. And the Rule of *Fellowship* is that by which in Accompts amongst divers Men, (their several Stocks together) the whole Loss or Gain being propounded, the Loss or Gain of each particular Man may be discovered.

4. The *Rule of Fellowship* is either Single or Double.

5. The *Single Rule of Fellowship* is, when the Stocks propounded are Single numbers; As in this Example: *A* and *B* were Partners in an Adventure to Sea, *A* put in 25 *l. B* 56, and upon return of the Ship, they sold the Fraight for 50 *l.* profit; the Question is, What part of this 50 *l.* is due to *A*, and what to *B*? To resolve this and the like Questions, the Sum of

E 3   the

the Stocks muſt be the firſt Term in the R
of Three , the whole gain the ſecond,
each particular Stock the third ; this done,
peating the Rule of Three , as often as th
are particular Stocks in the Queſtion,
fourth Term produced by theſe ſeveral ope
tions are the reſpeſtive Gains or Loſſes of th
particular Stocks propounded ; ſo in the preſ
Queſtion , the Reſolution will be as here
ſee.

$$81 . 50 :: \left.\begin{array}{c} 25 \\ 56 \end{array}\right\} \begin{array}{c} 15 . 432. \\ 34 . 567. \end{array}$$

6. The *Double Rule of Fellowſhip* is, wh
the Stocks propounded are double number
that is, when each Stock hath relation to
particular time.   *A, B,* and *C,* hire a piece
Ground for 45 *l. per Annum,* in which *A* h
24 Oxen 32 Daies, *B* 12, for 48 Daies, *C* 1
for 24 Daies; now the Queſtion to be reſolve
is, What part of the Rent each perſon muſt p

For this purpoſe you muſt firſt Multiply ea
particular Stock by its reſpeſtive Time, a
take the Total of their Products for the fi
Term, the Gain or Loſs for the ſecond, a
every mans particular Stock and Time for t
third; this done, repeating the Rule of Thr
ſo often as there are Products of the doub
Numbers; the fourth Terms produced up
thoſe ſeveral operations are the numbers ſough
So then in the Queſtion propounded, the Pr
duct of 24 and 32 is 768; the Product

2 and 48 is 576, and the Product of 16 and
4 is 384, the Sum of these Products is 1728,
which is the first Term, 45 *l.* the Rent is the
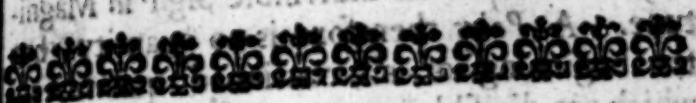second, and each particular Product the
third;

$$1728 \cdot 45 :: \begin{cases} 768 \cdot 20. \\ 576 \cdot 15. \\ 384 \cdot 10. \end{cases}$$

By which three Operations the Question is
Resolved.

FINIS.

THE *ENGLISH* ACADEMY:

The *THIRD PART.*

Of GEOMETRY.

CHAP. I.

Of the Definition and Division of Geometry.

GEOMETRY is the Art of Meaſuring well.

2. The Subject of *Geometry* is Magnitude, or continued Quantity, whoſe parts are joyned together by a common Term or limit.

3. *Magnitude* is either a Line, or ſomething made of a Line or Lines.

4. A *Line* is a Magnitude, conſiſting only of Length, without either Breadth or Thickneſs, the Term or limit whereof is a Point.

5. A

5. A *Point* is an indivisible Sign in Magnitude. A *Point* therefore is no quantity, but the beginning of all continued quantities, which are divisible in power infinitely.

6. A *Line* is either considered Simply by it self, or else comparatively with another Line.

7. A *Line* considered simply of it self, is either Right or Oblique.

8. A *Right line*, is that which lyeth equally between his Points.

9. An *Oblique line*, is either circular or mixt.

10. A *Periphery*, or Circular Line, is that which is equally distant from the middle of the comprehended space, which middle is called the *Centre*, and the distance between that Centre and the Circumference, is called the *Radius*.

11. Lines compared to one another are of the same or different Species.

12. Lines compared together of the same Species, are either Parallel or Angular.

13. *Parallel lines*, are such as are equally distant in all places, and are either Right lined Parallels, or Circular.

14. *Right lined Parallels*, are such as being in one and the self same plane, and infinitely produced on both sides, do never meet in any part.

15. A *Circular Parallel* is a Circle drawn within or without another Circle.

16. *Angular lines* are such as inclinining, or bowing to one another, touch one another, but not in a direct Line.

17.

17. An *Angle* is either Right or Oblique.

18. A *Right Angle*, is that whose legs or sides are Perpendicular to one another.

19. An *Oblique Angle*, is that whose legs or sides do incline to one another upon one side more than upon another.

20. An *Oblique Angle* is either Acute, or Obtuse.

21. An *Acute Oblique Angle*, is that which is less than a Right.

22. An *Obtuse Oblique Angle*, is that which is greater than a Right Angle.

23. The *Measure of an Angle*, is the Arch of a Circle described upon the Angular Point, and intersected between the sides of the Angle sufficiently prolonged; but of this Measure there can be no certain knowledge, unless the quantity of that Arch be expressed in Numbers.

24. Every Circle therefore is supposed to be divided into 360 equal parts, called Degrees, and every Degree into 60 Minutes, and every Minute into 60 Seconds, and so forward; others suppose every Degree to be subdivided into 10 parts, and every one of those into 10 more, and so forward, as far as you please.

25. A *Semi-circle* is the half of a whole Circle, and containeth 180 Degrees.

26. A *Quadrant*, or fourth part of a Circle, is 90 Degrees; and seeing that a Right Line falling Perpendicularly upon a Right Line, doth make the Angles on both sides equal, and cutteth a Semi-circle into two equal parts, the
fourth

fourth part of a Circle, or 90 Degrees, must needs be the Measure of a Right Angle.

27. Thus are Lines compared with Lines of the same Species, the comparing of Lines of different Species, is the comparing of Right Lines with those that are Oblique or Circular.

28. And *Right Lines*, as they have reference to, or are compared with the Circumference of a Circle, are either such as are inscribed within it, or applyed to it.

29. A *Right Line*, inscribed in a Circle, either passeth through the Centre, as the Diameter and Radius, or is drawn besides the Centre, as Chords and Sines.

30. A *Diameter*, is a Right Line inscribed through the Centre of the Circle, dividing the Circle into two equal parts.

31. The *Radius* of a Circle is the one half of the Diameter, or a Right Line drawn from the Centre to the Circumference; thus the Right Line *G B D*, in *Fig.* 1. is a Diameter, *G B*, or *B D*, the Radius.

32. A *Chord* or *Subtense*, is an inscribed Right Line drawn through or besides the Centre bounded at both ends with the Circumference.

33. A *Chord* or *Subtense*, drawn through the Centre is the same with the Diameter.

34. A *Chord* or *Subtense*, drawn besides the Centre, is a Right Line bounded at both ends with the Circumference, but alwayes less than the Diameter.

35. *Sines* are either Right or Verfed.

36. A *Right Sine* is half the Chord of the Double Arch, and it is either the whole Sine, and Sine of 90 Deg. or Sine lefs than the whole.

37. The whole Sine is equal to the Semidiameter or Radius of a Circle, as the Right Line *B E*.

38. A Sine lefs than whole, is half the Chord of any Arch lefs than a Semi-circle; as *C A* is the Sine of *C D*.

39. A *Verfed Sine*, is a part of the Diameter lying between the Right Sine and the Circumference, as the Right Line *A D*, which is one part of the Diameter, is the Verfed Sine of the Arch *C D*, and the Right Line *A G*, which is the other part of the Diameter, is the Verfed Sine of the Arch *C E G*.

40. A *Right line* applied to a Circle, is either a Tangent or Secant.

41. A *Tangent*, is a Right Line without but touching the Circle, drawn Perpendicular to the end of the Radius or Diameter, continued to the Secant.

42. A *Secant*, is a Right Line drawn from the Centre of the Circle, through the Term of an Arch, and continued to the Tangent; Thus the Right Line *F D*, is the Tangent, and the Right Line *B F*, is the Secant of the Arch *C D*, or of the Arch *C E G*, the Complement thereof to a Semi-circle.

43. Thefe Lines thus infcribed in, or applyed to a Circle, may to any limited Radius be drawn or made upon a Rule of Wood, Brafs, or other Metal.

Metal; or, a Table may be made, expressing
the Length of these Lines in numbers, answering
to every Degree and part of a Degree in the
Quadrant or Semi-circle; That is, the Lines of
Chords and Versed Sines may be made to any
part of a Semi-circle, and the Lines of Sines,
Tangents and Secants, to any part of a Qua-
drant: The use of such Scales and Tables, that
no Student in *Geometrie* can well be without
them; here therefore I will lay down such Pro-
positions as will sufficiently demonstrate the way
of making these Lines upon a Scale or Ruler,
but as to the construction of the Tables by
which the lengths of these Lines are expressed
in Numbers: I refer them to my *Trigonometria
Britannica*, and other Books of the like na-
ture.

Proposition I.

*Upon a Right Line given, to erect a Perpendi-
cular, from any Point assigned.*

Let it be required to erect a Perpendicular
to the Line *DG*, from the Point *B*, in *Fig.* 2.
take two equidistant Points, as *D* and *G*, open
your Compasses to a convenient distance, and
setting one Foot of your Compasses in *B*, draw
the Arch *EC*, and keeping your Compasses at
the same distance, set one Foot in *G*, and with
the other draw the Arch *HIF*, and through the
Intersections of these two Arches draw a Right
Line, as *BL*, which shall be perpendicular to the
Point *B*.   But

But if it were required to erect a Perpendicular from the end of a Line, do thus, your Compasses being opened to any convenient distance, set one Foot in the Point given, as at *A*, in the Line *A B*, and the other at *D*, or where you please, and making *D* the Centre, draw the Arch *C A E*, and from the points *C* and *D*, draw the Right Line *C D E*, then draw the Line *A C*, which shall be Perpendicular to the Line *A B*, from the point *A*, as was required.

Propositon II.

From a Point assigned without a Right Line given, to let fall a Perpendicular.

Let the given Line be *D G*, and let the point assigned be *L*, at the distance of *L D* draw the Arch *D A G F*, then setting one Foot of your Compasses in *D*, draw the Arch *I K*, and keeping your Compasses at the same distance, set one Foot in *G*, and with the other draw the Arch *M*, the Right Line *L B D*, drawn through the Intersections of those two Arches shall be perpendicular to *D G*, from the Point *L*, as was required.

But if it were required to let fall a Perpendicular from the point *E*, upon the Line *A B*, draw the Line *E D C* at pleasure, which being bisected at *D*, upon *D* as a Centre at the distance of *E D*, draw the Arch *E A C*, so shall the Line *E A* be Perpendicular to *A B*, as was required.

Propo.

Proposition III.

*To Divide a Right Line given into any Num-
ber of equal parts.*

Draw the Line *A C*, and from the points *A*
and *C* erect the Perpendiculars *A E* and *X C*
and at any distance of the Compasses, set off as
many equal parts as you please upon the Perpen-
diculars *A E*, and *X C*, and draw the Parallel
Lines *E X, F V, G T, H S, K R, L Q, M P,* and
N O; And let it be required to Divide the
Right Line into three equal parts, open your
Compasses to the length of the Line given, and
setting one Foot in *A*, where the other Foot
shall touch the third Parallel, make a mark,
which is at *Z*, draw the Line *A Z*, so shall the
Line *A Z* be Divided into three equal parts, as
was desired.

And thus may that Line be made, which is
commonly called the *Diagonal Scale.*

Proposition IV.

*How to Divide a Circle into 126 Parts, and
by consequence into 360.*

Draw the Diameter *B C*, and upon the point
A, describe the Circle *C D B L*, then draw
the Diameter *D A N*, at Right Angles, to the
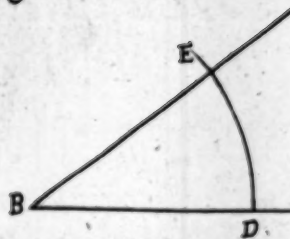Diameter *C A B*.

2. The Semidiameter or Radius of a Circle
will

Fig. 1

Fig. 2

Fig. 4

Fig. 3

Fig. 5

F

Fig. 6

Fig. 7

Fig. 8

Fig. 9.

Z
H   P
E
Q   L
G
A   D W   T   B
C
V
F
O
R ♌
N

Fig. 10

Z
H   S   P
E
T
A   D   B
K
Q
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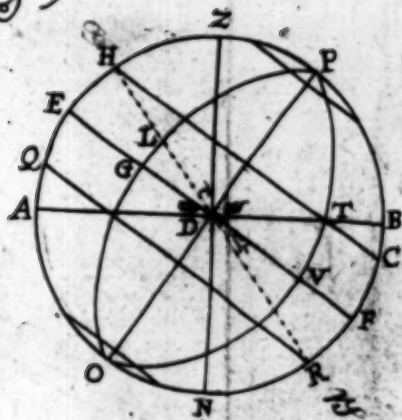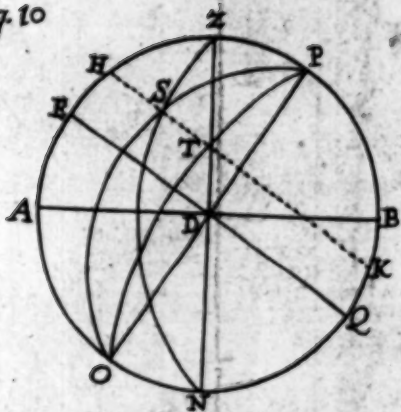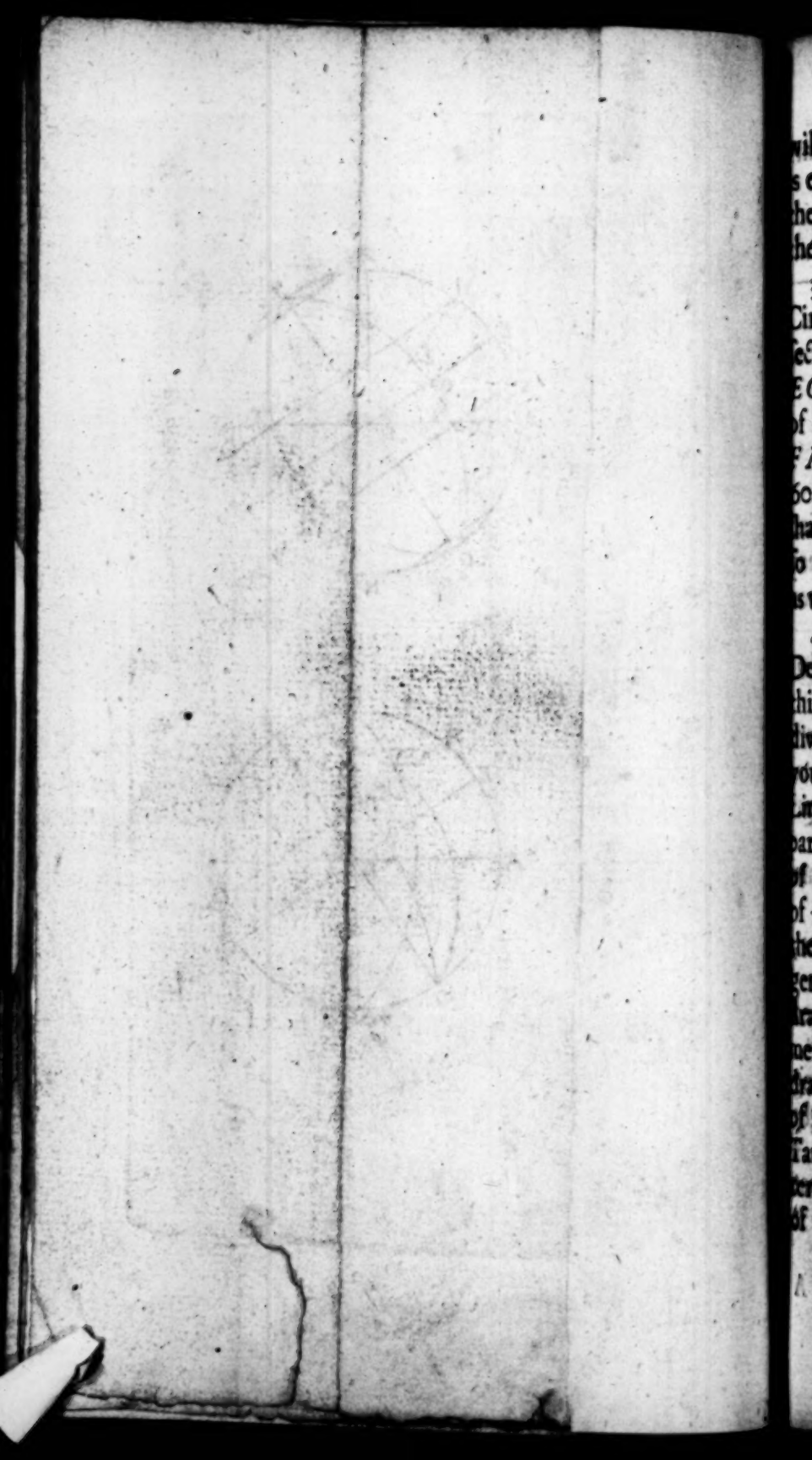of
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will divide the Circle into 6 equal parts, and so is equal to the Chord of 60 Degrees, *A C*, therefore being set from *D* to *F*, shall mark out the Arch *D F*, 60 Degrees.

3. The side of a *Pentagon* or fifth part of a Circle, is 72 Degrees; now then, if you bisect the Radius *A C* in the point *E*, and make *E G = E D*; then shall *D G = D M*, the side of a *Pentagon* or Chord of 72 Degrees, and *F M* the difference between *D M*, 72 and *D F* 60, that is the Chord of 12, which by bisection shall give the Chord of 6 and 3 Degrees, and so the Circle may be Divided into 120 parts, as was propounded.

4. A Circle being thus divided into 120 Degrees, the Arches are so equal, that the third part of the Chord of 3 Degrees will subdivide it into 36, without sensible errour; and your Circle being thus Divided into 360 parts, Lines at every Degree, or half Degree, drawn parallel to the Diameter, shall constitute the Line of Chords, and half those Chords, the Line of Sines; and the Segments of the Diameter, the Line of Versed Sines, and as for the Tangents and Secants, a Line touching the Circle drawn perpendicular to the end of the Diameter, and continued to the several Lines drawn from the Centre, through every Degree of the Quadrant, shall constitute the Line of Tangents, and those Lines drawn from the Centre to the Tangents, shall constitute the Line of Secants also. And thus may a Scale be made

made with the Lines of Sines, Tangents, Secants,
and equal parts.

CHAP. II.

Of *Right Lined Triangles.*

Hitherto we have spoken of the first kind
of *Magnitude*, that is, of Lines, as they
are considered of themselves, or among them-
selves.

2. The second kind of Magnitude, is that
which is made of Lines, that is a Figure.

3. A *Figure* is that which is every where
bounded, whether it be with one only limit as
a Circle; or with more, as a Triangle, Qua-
drangle, Pyramis, or Cube, &c.

4. The terms or limits of every Figure are
either Lines or Superficies.

5. A Figure which is terminated by Lines,
is a Superficies.

6. A Figure, which is bounded or limited
with several Superficies, is a Body or Solid.

7. A Superficies is a Magnitude, consisting
of length and breadth, and is either Right
Lined, Curve Lined, or composed of both.

8. A *Right Lined Plane* or *Superficies*, is that
which is Terminated with Right Lines; and it
is either a Triangle, or a Triangulate.

9. A

9. A *Triangle*, or the first Right lined Figure, is that which is comprehended by three Right Lines. It is distinguished from the Sides, or from the Angles.

10. In respect of the Sides, a Triangle is either *Isopleuron*, *Isosceles*, or *Scalenum*.

An *Isopleuron Triangle*, is that which hath three equal sides. An *Isosceles*, which hath two equal sides. And a *Scalenum*, whose three sides are all unequal.

11. In respect of the Angles, a Triangle is either Right or Oblique.

12. A *Right Angled Triangle*, is that which hath one Right line.

13. An *Oblique Angled plane Triangle*, is either Acute or Obtuse.

14. An *Oblique and Obtuse Angled plane Triangle*, hath two Acute Angles and one Obtuse; an Acute angled Triangle hath all the three Angles Acute.

15. The second sort of Right lined Planes is called a *Triangulate*, or a Plane, composed of *Triangles*.

16. The sides of a Triangulate, are in number more by two than the Triangles, of which it is composed.

17. A *Triangulate*, is either a *Quadrangle*, or a *Multangle*.

18. A *Quadrangle*, is a Plane comprehended, by four Right lines, and is either a *Parallelogram* or a *Trapezium*.

19. A *Parallelogram*, is a Quadrangle, whose

oppo-

made with the Lines of Sines, Tangents, Secants,
and equal parts.

CHAP. II.

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drangle, Pyramis, or Cube, &c.

4. The terms or limits of every Figure are
either Lines or Superficies.

5. A Figure which is terminated by Lines,
is a Superficies.

6. A Figure, which is bounded or limited
with several Superficies, is a Body or Solid.

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of length and breadth, and is either Right
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19. A *Parallelogram*, is a Quadrangle, whose
oppo-

F 2

oppofite fides are Parallel or Equidiftant, and
it is either Right Angled or Oblique.

20. A *Right Angled Parallelogram*, is that
which hath every Angle Right ; and it is either
a Square or an Oblong.

21. A *Square*, is a Right Angled Parallelo-
gram, whofe four fides are equal, and the An-
gles Right.

22. An *Oblong*, is a Right Angled Parallelo-
gram, whofe Angles are all right, but the Sides
unequal.

23. An *Oblique angled Parallelogram*, is that
whofe Angles are all Oblique, and is either a
Rhombus, or a *Rhomboides*.

24. A *Rhombus*, is an Oblique Angled Paral-
lelogram, of equal Sides.

25. A *Rhomboides*, is an Oblique angled Paral-
lelogram of unequal Sides.

26. A *Trapezium*, is a Quadrangle, but not a
Parallelogram, and it is either Right angled,
or Oblique

27. A *Right Angled Trapezium*, hath two
oppofite Sides, parallel, but unequal, and the
fides between them perpendicular.

28. An *Oblique Angled Trapezium*, is a Qua-
drangle, but not a Parallelogram, having at
leaft two Angles thereof Oblique, and none
of the Sides Parallel.

29. A *Right angled Multangled Plane*, is that
which is comprehended by more than four
Lines.

30. A *Multangled Right lined Plane*, or *Po-
lygon*, is either Ordinate and Regular, or In-
ordinate and irregular.　　　　31. Or

31. *Ordinate and Regular Polygons*, are such as are contained by equal Sides and Angles, as a *Pentagon*, *Hexagon*, &c.

32. *Inordinate or Irregular Polygons*, are such as are contained by unequal Sides and Angles.

32. Having thus shewed what a Right lined figure is, with the several sorts of them, we will now shew, how they may be Measured, both in respect of the Lines by which they are bounded, and also of their Area or Superficial Content.

33. And first we will shew how the Lines and Angles of all plane Figures, especially Triangles, may be Measured, as being the first and chiefest of them, and into which all other may be reduced.

34. The sides of all plane Triangles, and other plane Figures, are to be Measured by the Scale or Line of equal Parts.

35. The Angles may be Measured by the lines of Sines, Tangents, or Secants, as well as by the line of chords; but here it shall suffice to shew how any Angle may be protracted, or being protracted, be Measured by the line of Chords only.

These things premised, we will now shew you how all plane Figures may be Measured, in respect of their Sides and Angles, both

Proposition I.

How to protract or lay down an Angle to any quantity or number of Degrees proposed.

Draw a line at pleasure at *A B*, then open your Compasses to the number of 60 Degrees

in your line of Chords, and setting one of that
extent in *B*, with the other describe the Arch
CD, and from the point *B*, let it be required to
make an Angle of 40 Degrees ; open your
Compasses to that extent in the line of Chords,
and setting one Foot in *D*, with the other make
a mark as at *E*, and draw the line *EB*, so shall
the Angle *ABE* contain 40 Degrees, as was
required.

Proposition II.

*How to find the quantity of any Angle already
protracted.*

Let the quantity of the Angle *ABE*, be re-
quired ; open your Compasses in the line of
Chords, from the beginning thereof to 60
Degrees, and setting one foot thereof in the
point *B*, with the other describe the Arch *DE*,
then take in your Compasses the distance be-
tween *E* and *D*, and applying that extent to the
line of Chords, it will shew you the number of
Degrees contained in that Angle, which in our
Example will be found to be 40 Degrees.

These things premised, we will now shew
you how all plane Triangles may be Measured,
in respect of their Sides and Angles, both by
the Scale, and also by the Tables of Sines and
Tangents.

CHAP.

Plane Trigonometry.
CHAP. III.

Of the Solution or Mensuration of plane Triangles.

IN the Solution of plane Triangles, the Angles only being given, the Sides cannot be found, but the reason of the Sides only; it is therefore necessary, that one of the Sides be known.

2. In all plane Triangles, the three Angles are equal to two Right: two Angles therefore being given, the third is also given; and one of them being given, the sum of the other two is also given.

3. In a Right angled plane Triangle, one of the Acute Angles being given, the other is also given, it being the Complement of the other to a Quadrant or 90 Degrees.

4. In a Right angled plane Triangle, there are seven Cases, whose Solution shall be shewed in the Problems following.

5. The Sides comprehending the Right angle we call the Legs, and the subtending the Right angle, we call the *Hypothenuse.*

The Author follows the division of the Quadrant laid down in his Trigonometria Britannica viz.

F 4   **Problem**

The Quadrant into 90° and each degree into 100 parts or minutes.

Problem I.

The Legs given, to find an Angle and the Hypothenuse.

In the Right angled plane Triangle *A B C*, let there be given the Legs.

$$A B \; 512. \atop A C \; 384.\;\}\; \text{To find} \;\{\; {Hypot. \; BC. \atop Angl. \; B \; and \; C.}$$

Draw a line at pleasure, as *A B*, and upon the point *A*, erect the perpendicular *A C*, and by help of your Scale of equal parts, set off from *A* to *B*, 512, and also from *A* to *C*, 384, and draw the line *B C*, for the *Hypothenuse*, which being Measured by the Scale of equal Parts, will be found to be 640, and by the line of Chords, the Angle at *B* 36. 87, whose complement is the angle *A C B*, 53. 13.

By the Tables, the Proportions are,

1. *A B . A C :: Radius . tang. B.*

2. *B . A C :: Radius . B C.*

Problem II.

The Angles and one Leg given to find the Hypothenuse and the other Leg.

Draw a line at pleasure, as *A B*, and at Right
angles

angles to the point _A_ erect the perpendicular
_AC_, and by your Scale of equal parts set off
from _A_ to _B_ 512, and upon the point _B_ lay down
the angle _ABC_, 36.87. and draw the line _BE_,
till it cut the perpendicular _AC_, then Measure
the lines _BC_ and _AC_, by the Scale of equal
parts, so shall the one, to wit, _BC_, be the Hy-
pothenuse, and _AC_, the other Leg inquired.

By the Tables the Proportions are,

3. _Rad._ ‧ _AB_ :: _B_ ‧ _AC_

4. _Sine C_ ‧ _AB_ :: _Rad._ ‧ _BC_

Problem III.

The Hypothenuse and Oblique Angles given, to
find the Legs.

Draw a line at pleasure, as _AB_, and upon
the point _B_ protract one of the Angles given,
suppose the lesser _ABC_, 36.87. and draw the
line _BC_, and by your Scale of equal parts,
number the given Hypothenuse from _B_ to _C_ 640.
and from the point _C_ to the line _AB_, let fall
the Perpendicular _AC_, then is _BA_ one, and
_CA_, the other Leg inquired.

By the Tables, the Proportion is,

5. _Rad._ ‧ _BC_ :: _B_ ‧ _AC_

Problem IV.

The Hypothenuse and one Leg given, to find the
Angles and the other Leg.

Draw a line at pleasure, as *A B*, and by your
Scale of equal parts, number from *B* to *A*, the
quantity of the given Leg *A B*, 512. then
upon the point *A* erect the Perpendicular *A C*,
and opening your Compasses to the extent of
your Hypothenuse *B C* 640, set one Foot in *B*,
and move the other, till it touch the Perpendi-
cular *A C*, and there draw *B C*, so shall *A C* be
the Leg inquired, and either Angle may be
found by the line of Chords.

By the Tables, the Proportions are,

6. *B C* . *Rad.* :: *A B* . *Sine C.*

7. *Rad.* . *B C* :: *Sine B* . *A C.*

6. Hitherto we have spoken of Right angled
plane Triangles, the Problems following con-
cern such as are Oblique.

Problem V.

The Angles in an Oblique angled plane Triangle
and one side given, to find the other sides.

In the Oblique angled plain Triangle *B C D*,
let

let there be given the fide *CB* 632, and the Angles *DCB* 11.07. *D*. 26. 37.

Draw the line *C B* at pleafure, and by your Scale fet off from *C* to *B* 632, and upon thofe points protract the given Angles *DCB* 11.07 *CBD*. 142 : 56, and draw the lines *C D* and *B D*, till they interfect one another, then fhall the one fide be *C D* 865, and the other *D B* 273.

By the Tables, the Proportion is,

1. Sine *BDC* . *BC* :: s *DCB* . *DB*.

Problem VI.

Two fides and an Angle oppofite to one of them being given, to find the other Angles and the third fide, if it be known whether the Angle oppofite to the other given fide be Acute or Obtufe.

In the Oblique angled plane Triangle *BCD*, let there be given,

The Sides $\begin{cases} C B & 632 \\ C D & 865 \end{cases}$ Ang. *D*. 26. 37.

Draw the line *C D* at pleafure, and by your Scale fet off from *C* to *D*, 865, and upon the point *D* protract the Angle *CDB* 26. 37. and draw the line *D B*, then open your Compaffes to the length of the other fide *C B* 632, and fetting one foot in *C*, turn the other about till it touch the line *D B*, which will be in two places, in the point *B* or point neareft to *D*, if the Angle oppofite to the fide *CB* be Obtufe, but in the point *E*, or point fartheft from *D* if

Acute;

Acute; according therefore to the Species of that Angle, you muſt draw either the line CB or CE, and then you may meaſure the other Angles and the third ſide, as hath been ſhewed.

By the Tables, the Proportion is,

2. CB . Sine D :: CD . Sine B.

3.   Sine D . CB :: Sine C . BD.

Problem VII.

Two Sides with the Angle comprehended being given, to find the other Angles, and the third Side.

In the Oblique angled plain Triangle BCD, let there be given,

The Sides $\begin{cases} DC\,865 \\ BC\,632 \end{cases}$ Angle C. 11.07.

Draw a line at pleaſure, as DC 865, and by your Scale ſet off from C to D, 865, then protract the Angle at C 11.07, and draw the line BC, and by your Scale ſet off from C to B 632, and draw the line BD, and ſo have you conſtituted the Triangle BDC, in which you meaſure the Angles and the third ſide, as hath been ſhewed; but to reſolve this Problem by the Tables, it is ſomewhat more troubleſome.

1. To

1. To find the Àngles, the Proportion is,

$$\tfrac{1}{2} Zcru \cdot \tfrac{1}{2} X cru :: t \tfrac{1}{2} Z \angle\angle \cdot t \tfrac{1}{2} X \angle\angle.$$

$$\tfrac{1}{2} Z \angle\angle + \tfrac{1}{2} X \angle\angle = D B C.$$

$$\tfrac{1}{2} Z \angle\angle - \tfrac{1}{2} X \angle\angle = B D C.$$

2. To find the third Side.

$$Sine\ D \cdot B C :: Sine\ C \cdot B D.$$

Problem VIII.

The three sides given to find an Angle.

Let the given sides be $D C$ 865. $B C$ 632. and $D B$ 273.

Draw a line at pleasure, as $D C$, and by your Scale set off from C to D 865, then open your Compasses to the extent of either of the other sides, and setting one foot of your Compasses in C, with the other draw an Occult arch, then open your Compasses to the extent of your third side, and setting one foot in D, with the other foot describe another Arch cutting the former in the point B, then will the Lines $B C$ and $D B$, constitute the Triangle, whose Angles may be measured, as hath been already shewed.

To resolve this Problem by numbers, the Proportions are for the Segments of the Base.

As

As the base is to the sum of the other sides, so is the difference of those sides to the difference of the Segments of the Base; which being subtracted from the Base, half the Remainer will shew where the Perpendicular must fall, suppose at *F*, and constitute the two Right angled Triangles *B D F*, and *F D C*, in which we have given the Hypothenuses *B D* and *D C*, and the Legs *B F* and *C F*, and therefore we may find the Angles of those Triangles, as hath been shewed in the fourth Problem.

Problem IX.

To find the Superficial content of Right lined Figures.

Having shewed the Mensuration of Triangular planes in respect of their sides and Angles, we will now shew how the Area or Superficial content of them, and any other plane Figures may be found: And because all many-sided Figures may be best Measured by reducing them first into Right angled Triangles, Quadrangles, or Trapezias, we will first shew how the Area or Superficial content of these Figures may be readily found; and first of a Right or Oblique angled plane Triangle.

2. To Measure the Right angled plane Triangle *B D F*, in Fig. 7. Multiply *B F* by *F D*, half the Product shall be the content.

3. To Measure the Oblique angled plane Triangle *B D C*, let fall the Perpendicular *D F*, then

then Multiply BC by DF, half the Product shall be the content.

4. To find the Area or Superficial content of any Oblique angular Trapezium, convert it into two Oblique angled Triangles, by a Diagonal, as the line B D in the *Trapezium A B C D*, then turn the Oblique angled Triangles into Right, by letting fall the Perpendiculars A E and C F, then Multiply B D by the sum of A E and C F, half the Product shall be the content. In like manner may any other Irregular Multangle be also measured by turning it into Triangles and Trapeziums, and computing them severally, and adding all their contents together.

Vide A.

Problem I.

The Diameter of a Circle being given, to find the Circumference.

Vide B.

The Circumference of a Circle whose Diameter is 1, is 3.14159 and therefore,

As 1 is to 3.14159, so is any other Diameter, to the Circumference answering that Diameter.

Problem II.

*The Diameter of a Circle being given, to find
the Superficial content.*

Archimedes hath Demonstrated, that the
Area of a Circle is equal to the content of a
Right angled plane Triangle, whose Legs com-
prehending the Right angle, are one of them
equal to the Semidiameter, and the other to
the Circumference of a Circle. And there-
fore the Area or Superficial content of a Cir-
cle may be found, by Multiplying half the
Circumference by half the Diameter, or the
whole Diameter by the fourth part of the
Circumference, they taking the Diameter of
a Circle to be one, and the Circumference
3.14159, the Superficial content of such a
Circle will be found to be 0.7853975.

And therefore, As 1 is to 78539, so is the
Square of any other Diameter to the Superfi-
cial content required.

Problem III.

*The Diameter of a Circle being given, to find
the Side of a Square which may be inscribed with-
in the same Circle.*

The Chord or Subtense of the fourth of a
Circle, whose Diameter is 1, is 7071067;
therefore, as one, to 7071067, so is the
Diame-

Diameter of any other Circle, to the Side required.

Problem IV.

The Circumference of a Circle being given, to find the Diameter.

By the Diameter to find the Circumference, the proportion by the tenth Problem, is ; As 1 to 3.14159, so the Diameter to the Circumference, and therefore putting the Circumference of a Circle to be 1.

As 3.14159 . 1 :: 1 . .318308.

And therefore as 1 to 318308, so is any other Circumference, to the Diameter sought.

Problem V.

The Circumference of a Circle being given, to find the Superficial content.

As the Square of the Circumference of a Circle given, is to the Superficial content of that Circle, so is the Square of the Circumference of any other Circle, to the Superficial content of that other Circle.

And in a Circle whose Diameter is 1, the Circumference is 3.14159, and the Area 7853975, and supposing an Unite to be the Circumference of a Circle, it is, as the Square of 3.14159 . 7853975 :: 1 . 0.079578, and therefore, As 1 . 0.079578, so is the

G   Square

Square of any other Circumference, to the Area desired.

Problem VI.

The Circumference of a Circle being given, to find the side of a Square which may be inscribed within the same Circle.

As the Circumference of a Circle whose Diameter is 1, *viz.* 3.14159, is to 707107, the side of the inscribed Square of that Circle, so is the Circumference of any other Circle, to the side inquired; and putting the Circumference to be Unity, it is, as 3.14159 . 707107 :: 1 . 225078, therefore,

As 1 *to* 225078, *so* is the Circumference given, to the side inquired.

Problem VII.

The Superficial content of a Circle being given, to find the Diameter.

This is the Converse of the 11. *Problem*, the Diameter given, to find the Content, for which the Proportion is; *as* 1 *to* 7853975, *so* is the Square of the Diameter, *to* the Content: and therefore we must say; *as* 7853975 *is to* 1 *so* 1 *to* 1.27324; and hence, *as* 1 *to* 1.27324, *so* is the Area, *to* the Square of the Diameter.

Problem

Problem VIII.

The Superficial content of a Circle being given, to find the Circumference.

This is the Converse of the 14. *Problem*, the Circumference given, to find the Content.

As 1 *to* 079578, *so* Circumference Square, *to* the Content. And therefore,

As 079578 . 1 :: 1 . 12.5664, and by consequence,

As 1 *to* 12.5664, *so* the Area, *to* the Square of the Circumference.

Vide C.

Problem IX.

The Axis or Diameter of a Sphere being given, to find the Superficial Content.

As the Square of the Diameter of a Circle, which suppose 1, *is to* 3.14159 the Area, *so is* the Square of the Axis given, *to* the Area that is required.

G 2　　CHAP.

CHAP. IV.

Of Bodies or Solids.

AFter the Description of Lines and Planes, the Doctrin of Bodies is to be considered.

2. A *Solid* or *Body*, is that which hath Length, Breadth and Thickness, whose bounds or limits are Superficies.

3. A *Solid* is either Plane or Gibbous.

4. A *Plane Solid*, is that which is comprehended of Plane Superficies, and is either a Pyramide or Pyramidate.

5. A *Pyramide*, is a solid Figure, which is contained by several Planes, set upon one Plane or Base, and meeting in one point.

6. A *Pyramidate*, is a solid Figure, composed of Pyramides, and is either a *Prisme* or a mixt *Polyhedron*.

7. A *Prisme*, is a Pyramidate or solid Figure, contained by Planes, of which these two which are opposite, are equal, like, and parallel, and all the other Planes are Parallelograms.

8. A *Prisme*, is either a *Pentahedron*, an *Hexahedron*, or a *Polyhedron*.

9. A *Pentahedron Prisme*, is that, which is comprehended of five Sides, and the Base a Triangle.

10. An *Hexahedron Prisme*, is that which is comprehended of six Sides, and the Base a Quadrangle.

11. An

11. An *Hexahedron Prisme*, is either a *Parallelipipedon*, or a *Trapezium*.

12. A *Parallelipipedon*, is that whose sides or opposite Planes are Parallelograms.

13. A *Prisme*, called otherwise a *Trapezium*, is that solid, whose opposite Planes, or Sides are neither Parallel nor Equal.

14. A *Parallelipipedon*, is either Right angled or Oblique.

15. A *Right angled Parallelipipedon*, is that which is comprehended of Right angled Sides, and it is either a *Cube* or an *Oblong*.

16. A *Cube*, is a Right angled Parallelipipedon of equal Sides.

17. An *Oblong*, is a Right angled Parallelipipedon of unequal Sides.

18. An *Oblique angled Parallelipipedon*, is that which is comprehended of Oblique Sides.

19. A *Polyhedron*, is that which is comprehended of more than five Sides, and the Base a Multangle.

20. A mixt *Polyhedron*, is that whose Vertex is in the Centre, and the several Sides exposed to view, and of this sort, there are only three; the *Octahedron*, the *Icosahedron*, and the *Dodecahedron*.

21. An *Octahedron*, is a solid Figure, which is contained by eight Equal and Equilateral Triangles.

22. An *Icosahedron*, is a solid Figure, which is contained by twenty Equal and Equilateral Triangles.

23. A *Dodecahedron*, is a solid Figure, which

is contained by twelve Pentagons, Equilateral and Equiangled.

24. A *Gibbous folid*, is that which is comprehended of Gibbous Superficies, and it is either a Sphere or Various.

25. A *Sphere*, is a Gibbous body, absolutely round and Globular.

26. A *Various Gibbous Body*, is that which is comprehended by Various Superficies and a Circular Base; and is either a *Cone*, or a *Cylinder*.

27. A *Cone*, is a Pyramidical Body, whose Base is a Circle.

28. A *Cylinder*, is a solid Body of equal thickness, having a Circle for its Base. The solid content of these several Bodies may be measured by the Problems following.

Problem I.

The Base and Altitude of a Pyramide of Cone given, to find the Solid Content.

Multiply the Altitude by a third part of the Base, or the whole Base by a third part of the Altitude, the Product shall be the Solid Content required.

Problem

Problem II.

The Base of a Prisme or Cylinder being given, to find the solid Content.

Multiply the Base of the Prisme or Cylinder given, by the Altitude: the Product shall be the solid Content.

Problem III.

In a Piece or Frustum of a Pyramide, Cone or other irregular Solid, both the Bases being given, to find the content.

If the Aggregate of both the Bases of the Frustum, and of the mean Proportional between them, be drawn into the Altitude of the Frustum, the third part of the Product shall be equal to the solid Content required.

Problem IV.

The Axis of a Sphere being given, to find the Solid Content.

A Sphere (as *Archimedes* hath shewed) is equal to two thirds of a Cylinder circumscribing it; now then, such a Cylinder being made, by the Area of a Circle multiplied by the Diameter; and therefore the Area of a Circle being multiplyed by two thirds of the Diameter,

the

the Product shall be the solid content of a Sphere.

The Area of a Circle whose Diameter is 1, is 785975; which being multiplied by 666666, the two thirds of the Diameter, the Product 523598 is the solid content of such a Sphere; therefore,

As 1 to ·523598, so is the Cube of any Axis given, to the solid content required.

Problem III.

In a Piece or Portion of a Pyramid, Cone, or other irregular Solid, both the Bases being given, to find the content.

If the Aggregate of both the Bases of the Frustum, and of the mean Proportional between them, be drawn into the Altitude of the Frustum, the third part of the Product shall be equal to the solid Content required.

FINIS.

Problem IV.

The Axis of a Sphere being given, to find the Solid Content.

A Sphere (as Archimedes hath shewed) is equal to two thirds of a Cylinder circumscribing it; now then, such a Cylinder being made, by the Area of a Circle multiplied by the Diameter; and therefore, the Area of a Circle being multiplied by two thirds of the Diameter, the

C 4

f4f4# THE ENGLISH ACADEMY.

The FOURTH PART

OF MUSICK.

CHAP. I.

Of SINGING.

MUSICK is the Art of modulating Notes in Voice or Instrument.

2. It doth consist in *Singing* or *Setting*.

3. In *Singing* there are five things to be considered : 1. The Number of the Notes. 2. Their Names. 3. Their Tunes. 4. Their Times. And 5. Their Adjuncts.

4. The number of Musical Notes are three times Seven, or twenty one, that is from the lowest Note of a Man's *Base*, to the highest of a Boy's *Treble*, we usually reckon twenty one Notes;

Notes; though there are some *Bases* that reach
below, and some *Trebles* that arise above this
ordinary Compass.

5. The number of Musical Notes is there-
fore divided by Septenaries, because there are
in Nature but seven distinct Sounds exprest
in Musick, by seven distinct Notes, in the se-
veral *Cliffs* or *Cleaves* of the Scale; for the
eighth and fifteenth have the Sound or Tune,
and therefore the *name* and *cliff* of the first;
the 9th and 16th of the second; the 10th and
17th of the third; the 11th and 18th of the
fourth; the 12th and 19th of the fifth; the
13th and 20th, of the Sixth; the 14th and 21th,
of the seventh.

6. These thrice Seven Notes are descerned
by their places. A *place* is either Rule or Space,
and therefore in eleven Rules with their Spaces,
is comprehended the whole Scale.

7. At the beginning of each Rule and Space
is placed one of the first seven Letters in the
Alphabet; and these Letters are thrice repea-
ted one above another; the Letter *G* being put
upon the first or lowest place of each Septenary
being the first letter in the word *Greece*, and
in the first Septenary, retaineth the Name and
Form of the Greek *Gamma*, in remembrance,
that the Art of *Musick*, as other learned Arts
came to us from that seat of the Muses.

8. By these seven Letters of the Alphabet,
otherwise called seven *Cliffs*, or *Cleaves*, the
Scale is divided into Three several Parts of
Musick; The first and lowest is called the *Base*;
the

the second or middle Part, the *Mean* ; the third or higheſt Part, the *Treble*. As for the Notes, which do exceed this compaſs, either in the *Baſe* or *Treble* ; they are ſigned with double Letters in the ſame manner, that the ordinary Notes are with ſingle.

9. The ſecond thing to be conſidered in *Singing*, is the Name by which each of theſe Notes is called.

10. And for theſe ſeven Notes, ſigned by the firſt ſeven Letters in the Alphabet, there are but ſix ſeveral names invented to help the Learner in the Tuning of them; *ut, re, mi, fa, ſol, la,* and for the ſeventh Note, becauſe it is but half a Tone above *la* ; as the fourth is above *mi* ; (whereas the reſt are all whole Tone) it is fitly called by the ſame Name with the fourth, and ſo the next will be an Eight, or *Diapaſon* to the firſt, and conſequently placed in the ſame Letter or Cliff, and called by the ſame name.

And thus they were wont to be placed in the Scale, in which the firſt Name *ut* being placed upon the ſame line with the Greek *Gamma*, hath cauſed the whole Scale to be called the *Gamut* ; but modern Muſicians in theſe latter times, have rejected the Names of *ut* and *re* ; as finding the other four to be ſufficient for the expreſſing of the ſeveral Sounds, and leſs burthenſome to the Memories of Practitioners.

11. This Scale or *Gamut* then is divided into four Columns. In the firſt you have the Alphabetical Letters or Cliffs, the other three ſhew the Names of the Notes, Aſcending and

Γ ſol

Defcending, according to their feveral Names
and Keys.

In the fecond Column is fet the Names of the
Notes as they be called, when is *B duralis*, or
B fharp, as having no flat in *B mi*, and then your
Notes are called as they are fet there on the
Rules and Spaces Afcending.

In the third Column is *B proper*, or *B naturalis*,
which hath a *B flat* in *B mi* only, which is put
at the beginning of the line with the Cliff, and
there you have alfo the Names as they are called
on Rule and Space.

In the fourth Column is *B fa*, or *B mollaris*,
having two *B flats*, the one in *B mi*, the other
in *E lami*, placed as the other; by obferving of
which you have a certain Rule for the Names of
the Notes in any part.

12. In thefe three Columns obferve this for
a general Rule, that what Name any Note hath,
the fame Name properly hath his Eight above
or below.

13. Although the whole ordinary Scale of
Mufick doth contain three feptenaries of lines
and fpaces; yet when any of the parts which
it is divided into, fhall come to be Prick'd out
by it felf in *Songs* or *Leffons*, five Lines is only
ufual, for one of thofe Parts, as being fufficient
to contain the compafs of Notes thereunto be-
longing: And if there be any Notes that extend
higher or lower, it is ufual to add a Line in that
place with a Pen.

		B Duralis 1	B Naturalis 2	B Molaris 3
ee	la mi re	la	la	mi
dd	Sol re ut	Sol	Sol	la
ff	fa ut	fa	fa	Sol
E	la	la	mi	b fa
D	la Sol	Sol	la	la
C	Sol fa	fa	Sol	Sol
B	fa # mi	mi	b fa	b fa
A	la mi re	la	la	mi
G	Sol re ut	Sol	Sol	Sol
ff	fa ut	fa	fa	Sol
E	mi	mi	mi	b fa
D	la sol re	Sol	la	la
C	Sol fa ut	fa	Sol	Sol
B	fa # mi	mi	b fa	b fa
A	la mi re	la	la	mi
G	Sol re ut	Sol	Sol	la
F	fa ut		fa	Sol
E	la mi	la	mi	b fa
D	Sol re	Sol	la	la
C	fa ut	fa	Sol	Sol
B	mi	mi	b fa	b fa
A	re	la	la	mi
G	Fa mi ut	Sol	Sol	la
FF	fa ut	fa	fa	Sol
EE	la mi		mi	fa
DD	Sol re	Sol	Sol	la
CC	fa ut		Sol	la

The Treble or highest Keyes

The Meane or middle Keyes

The Base or lowest Keyes

14. Though the seven Letters set at the beginning of each Rule and Space, are seven *Cleaves*, yet four of them are only usual. The first is called the *F fa ut Cleave* or *Cliff*, thus marked 𝄢 this is proper to the *Base* or lower Part, and is set upon the fourth line, at the beginning of Songs or Lessons. The second is the *C sol fa ut*, which is proper to the middle or inner Parts, and is thus marked 𝄡. The third is the *G sol re ut Cleave* or *Cliff*, which is only proper to the *Treble* or highest, and is signed thus, 𝄞 on the second line of the Songs or Lessons; and these are called the three signed Cliffs.

The fourth is the *B Cliff*, which is proper to all Parts, as being of two natures and properties; that is to say, *Flat* and *Sharp*, and doth only serve for the *Flatting* and *Sharping* of Notes; it is called by two Names, and signed by two Marks, the one is *B fa* or *B flat*, and is known on Rule or Space by this mark, (♭). The other is called *B mi* or *B sharp*, and is known by this mark ♯.

15. Concerning this fourth Cliff, you are to observe: 1. That the *B fa*, or *B flat* doth alter both the Name and Property of the Notes before which it is placed; changing *mi* into *fa*, and making that Note to which he is joyned, a Semi-tone, or half a Note lower. 2. That the *B mi* or *B sharp* alters the property of the Notes before which he is placed, but not the Name; for he is usually placed either before

fa

fa or *sol*, and they retain their name still, but their sound is raised half a Tone or Sound higher. Lastly, note, that these two *B Cliffs* are placed not only at the beginning of the Lines with the other Cliff, but is usually put to several Notes in the middle of any Song or Lesson, for the *flatting* and *sharping* of Notes, as the Harmony of the Musick doth require.

16. Of these four Notes now in use, *Mi* is the principle or master Note, for that being found, the rest are known by this direction; after *Mi*, sing *fa sol la*, twice upward, and *la sol fa*, twice downward, and so you come to *Mi* again in the same Cliff both waies.

17. This Note *Mi*, hath his being in four several places, but he is but in one of them at a time. Its proper place is in *B mi*, as in the second Column of the *Gamut*; but if a *B fa*, or *B flat*, be in its place, then he is in *E la mi*, as in the third Column of the *Gamut*, which is its second place. But if a *B flat* be placed there also, then its in *A la mi re*, which is its third place. If a *B flat* come there also, then it is removed into its fourth place, which is *D la sol re*, according to these Examples.

I. *Example.*   *Mi* in *B mi.*

Sol   la   mi   fa   sol   la   fa   sol.

II. *Ex-*

II. Example.   Mi in E la.

Sol   la   fa   sol   la   mi   fa   sol.

III. Example.   Mi in A la mi re.

La   mi   fa   sol   la   fa   sol   la.

IV. Example.   Mi in D la sol.

La   fa   so   la   mi   fa   sol   la.

I. Example.   Mi in B mi.
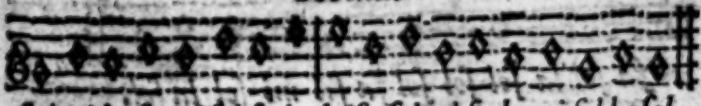
Sol la mi fa la fa la

CHAP.

CHAP. II.

Of the Tunes of Notes.

THe next thing to be confidered in Singing,
is the Tunes of Notes, which cannot be
declared by Precept, but muft be learned ei-
ther by the lively Voice of the Teacher, or by
fome Inftrument rightly Tuned. Only obferve
that from *mi* to *fa*, and fo from *la* to *fa*, is but
half a Tone; but between any other two
Notes is a whole Tone, as from *fa* to *fol*, or *fol*
to *la*. And in the firft guiding of the Voice,
it will much help, if at the firft Tuning, you
found by degrees all thefe Notes, as *fol la mi*,
and at the fecond Tuning, leave out *la* the mid-
dle Note: this will not only help you to Tune
a Third, as from *fol* to *mi*, but it will alfo help
you in the raifing of Fourths and Fifths, *&c.*
  Of which there are fome Examples in the
plain Songs following.

Firft.

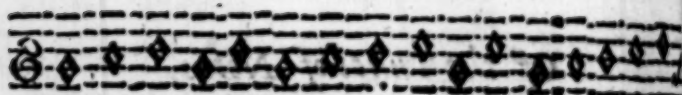*Sol la mi fa fol la fa fol   fol fa la fol fa mi la fol.*

Second.

Sol mi la fa mi fol fa la la fa fol mi fa la mi fol la fol.

H   *Third*

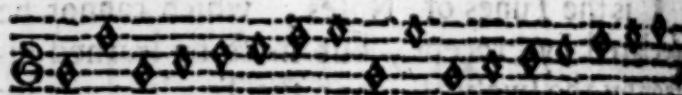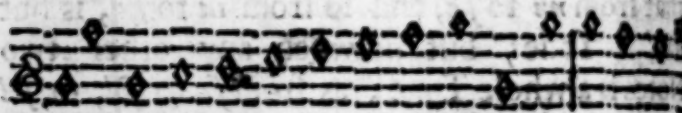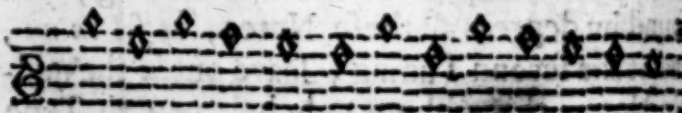### Third.

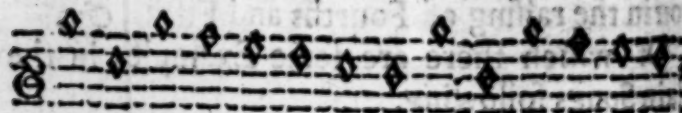Sol la mi sol mi sol la mi fa sol fa sol la mi fa sol

sol sol sol la mi fa sol la sol la sol la mi fa sol la fa

sol fa sol la mi fa sol la fa sol sol sol sol fa la

sol la sol fa la sol sol sol sol fa la sol fa

sol fa sol fa la sol fa mi sol mi sol fa la sol

fa mi la sol la sol fa la sol fa mi la sol sol sol

fa sol la sol sol sol fa sol mi sol la sol.

CHAP.

CHAP. III.

Of the Time of Notes.

THe Notes in *Musick* have two names, one
for *Tune*, the other for *Time* or Proportion.
The Names of Notes in reference to their
Tunes, are, as hath been said, these four,
Sol La Mi Fa; And their Names in Proportion
of *Time*, are Eight; A *Large*, a *Long*, a *Breve*,
a *Semi-breve*, a *Minum*, a *Crotchet*, a *Quaver*,
and a *Semi-quaver*.

The four first are of Augmentation, or In-
crease; the four latter are of Diminution or
Decrease, and are thus proportioned. The
Large being the first of Augmentation, and
longest in Sound; the *Semi-breve* is the last of
Augmentation, as the shortest in Sound, and
in *Time* is called the Master Note, being of
one Measure by himself, all the other Notes
are reckoned by his value, both in Augmenta-
tion and Diminution.

In Augmentation, the *Large* is eight *Semi-
breves*, the *Long* four, the *Breve* two, the *Semi-
breve* is one *Time* or *Note*.

In Diminution, the latter four do decrease in
this proportion; two *Minums* make a *Semi-
breve*, two *Crotchets* make a *Minum*, two
Quavers make a *Crotchet*, and two *Semi-quavers*
make a *Quaver*. As in the Table following
may be seen.

Notes

Notes of Augmentation.

A Large.

A Long.

A Breve.

A Semibreve.

Notes of Diminution.

A Semibreve.

A Minum.

A Crotchet.

A Quaver.

A Semiquaver.
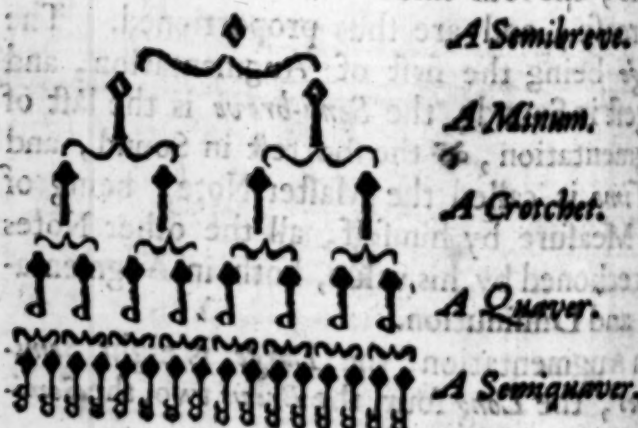
CHAP.

CHAP. IV.

Of the Adjuncts belonging to Musical Notes.

THere belong to Notes, thus described by their Number, Names, Tunes, and Time, these seven things. *A Tye*, a *Repeat*, a *Pause*, a *Direct*, a *Close*, with single and double *Bars*, and several *Moods*.

2. A *Tye* is a Semi-circle, whose two ends point to the two Notes conjoyned, as when two *Minums*, or one *Minum* and a *Crotchet* are Tyed together; as also, when two or more Notes are to be Sung to one Syllable, or two Notes or more to be plaid with one drawing of the Bow on the *Viol* or *Violin*.

3. The middle and principal Note is the *Semibreve*: And when any Note and his half Note in the same place are conjoyned for one Syllable, the mark of the half Note, and of the Ligature too, is a point set by the Note, as and it is as much, as if with the Note his half Note were exprest, and conjoyned by Ligature, and prolongeth the sound of that Note it follows, to half as much more; thus a *Semibreve*, which is of it self but two *Minums*, having a prick after it, is made three *Minums*, in one continued sound, and so in other Notes.
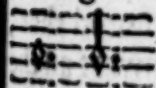
4. A *Repeat* is either of the same Notes and

Ditty

Ditty together, or of Ditty with other Notes, and is marked thus, ℞ and is used to signifie, that such a part of a Song or Lesson, must be Play'd or Sung over again from that Note over which it is placed.

5. A *Pause* is a mark of rest or silence in a Song for the time of some Note, whereof it hath its name. A line descending from a superiour Rule, and not touching the Rule below, is a *Semibreve* Rest: the like line rising f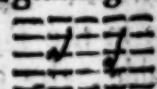rom an inferiour Rule, and not touching the Rule above, is a *Minum* Rest; the same with a crook to the Right hand, is a *Crotchet* Rest, and to the left hand, a *Quaver* Rest: Also a line reaching from Rule to Rule, is a *Breve* Rest, or a *Pause* of two *Semibreves*; a line from a Rule to a third Rule, is a *Long* pause, or of four *Semibreves*, and two of them together make a *Large* pause, or a Rest of Eight *Semibreves*.

6. A *Direct* in the end of a line, sheweth where the Note stands in the beginning of the next line, and is marked thus,

7. A *Close*, is either Perfect or Imperfect; A Perfect Close is the end of Song, noted thus, or thus, or with two Bars thwart all the Rules, or both wayes. An Imperfect Close, is the end of a Strain, or any place in a Song, where all the Parts do meet and Close before the end, and it is marked with a single Bar.
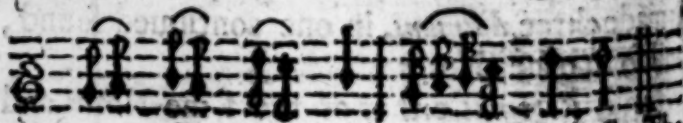
8. The

8 The ufual *Moods* are two, the *Imperfect of the more*, when all goes by two, except the *Minims*, which goes by three, as two *Longs* to a *Large*, two *Breves* to a *Long*, two *Semibreves* to a *Breve*, three *Minums* to the *Semibreve*, with a prick of perfection; this Mood is thus figned, ℭ₃ and is ufually called the *Triple Time*.

The other ufual *Mood* is the *Imperfect of the lefs*; when all goes by two, as two *Longs* to a *Large*, two *Breves* to a *Long*, two *Semibreves* to a *Breve*, &c. this is called the *Common Time*, becaufe moft ufed, and is marked thus, ℭ.

Thus much concerning Singing; I leave Setting to the larger Treatifes of this fubject.

FINIS.

THE *ENGLISH* ACADEMY:

The FIFTH PART.

OF ASTRONOMIE.

CHAP. I.

Of the General Subject of Astronomie.

AStronomy, is an **Art**, by which we are Taught the **Measure** and **Motion** of the heavenly **Orbs** and **Stars** that are in them.

2. The Heavenly Orbs are either ἄναστροι, without Stars, as the *Primum Mobile*, or ἄστροι, such as have Stars in them, as the eight inferiour Orbs.

3. The Stars are either fixed or moveable: The fixed Stars are those which alwayes keep the same distance from one another: but the moveable Stars, otherwise called Planets, are **such**

such as do not always keep the same distance.

4. All the Stars, as well fixed as moveable, have a double motion ; the one occasioned by the *Primum Mobile*, from East to West, the other natural or proper to themselves, by which they move from West to East.

5. According to this double motion of the Stars, this Art of *Astronomy* is divided into two Parts ; the first sheweth the motion of the *Primum Mobile* , and how the several Heavenly Orbs are by that carried round the World, from East to West , which is called the *Diurnal motion* of the Stars.

The second part of *Astronomy* , sheweth the *Periodical motion* of the Stars , in which the inferiour Orbes, according to their own proper and natural motion, do move from West to East.

6. For the better understanding of these several motions , the *Primum Mobile* , or tenth Orb, is usually represented by a Sphere or Globe , with such lines drawn about it as the Stars in their motions are supposed to make, or may help to discover unto us , the quantity of their motions , and shew the time of their Risings and Settings, and such like.

7. This Sphere or Globe , is a round Body, containing one Superficies, in the middle whereof there is a Point, from whence all Right Lines drawn to the Superficies are equal.

8. In the Sphere or Globe, there are ten imaginary Lines or Circles, of which six are great, and four are small.

9. The

9. The great Circles are thefe which divide the Sphere or Globe into two equal *Hemifpheres*, and fuch are the *Horizon*, *Æquinoctial*, *Zodiack*, and the two *Colures*; the two firft of which are called *external* and *mutable*, the other *internal* and *immutable*.

10. The Leffer Circles, are thofe which divide the Sphere or Globe, into two unequal *Hemifpheres*, whereof one is more, and the other lefs than the half of the Sphere or Globe; fuch are the two *Tropicks* of *Cancer* and *Capricorn*, and the *Artick* and *Antartick* Circles, all which are reprefented in *Fig. 9*.

11. The *Horizon*, which is alfo called the *Finitor*, is a Circle, which divideth the vifible part of the Heavens from the not vifible; that is, the lower *Hemifphere* from the upper, as the line *AB*; one of whofe Poles is in the Point directly over our heads, and is called the *Zenith*, the other Diametrically oppofite, called the *Nadir*, and noted with the Letters *Z. N.*

12. The *Horizon*, is either *Senfible* or *Rational*.

13. That is called the *Senfible Horizon*, which bounds our fight, and feemeth to divide the Heavens into two equal Hemifpheres.

14. And that is called the *Rational* or *Intelligible Horizon*, which doth indeed bifect the Heavens; and this is Right, when it paffeth through the Poles of the World; or Oblique, when one of the Poles is fomewhat elevated, and the other depreffed; or Parallel, when one Pole is in the Vertical Point or *Zenith*, for then

the

the *Horizon* is Parallel to the *Æquator*; it otherwise makes therewith either Right or Oblique Angles.

15. Hence there is a threefold position of the Sphere. 1. A *Right*, where the *Horizon* Right; that is, where the *Æquator* passeth through the *Zenith* and *Nadir*. 2. Oblique, when the *Horizon* is *Oblique*; that is, when one Pole is somewhat elevated and the other depressed. 3. *Parallel*, when one of the Poles of the World is in the *Zenith*.

16. In a *Right Sphere*, all the Stars do Rise and Set, but in an *Oblique Sphere*, some are hid from our sight, and some are always above the *Horizon*, and never set.

17. The *Meridian* is a great Circle, peculiar and proper to every place, and drawn through the *Vertical point* and the *Poles of the World*, to which when the Sun comes in his Diurnal motion, in the Day-time he maketh Mid-day, and in the Night-time, he maketh Midnight. There may be as many *Meridians* as there are *Vertical points*, but upon the Globe they are usually drawn through every tenth or fifteenth Degree of the *Æquator*.

CHAP.

CHAP. II.

Of the Internal and Immutable great Circles.

Hitherto of the two External and Mutable Circles, the *Horizon* and *Meridian*; I come now to the Internal and Immutable.

2. The first Internal and Immutable Circle is called the *Æquator*, or *Equinoctial Circle*, which divideth the whole Sphere or Globe into two equal parts between the Poles, to which, when the Sun cometh, which is twice in the Year, the Daies and Nights are equal in all places but in a Parallel Sphere : this Circle is noted with the letters *E F*. *Fig. 6*

3. This Circle is also the measure of Time; for as oft as 15 Degrees of this Circle do ascend above the *Horizon*, so many Hours are completed in its going round.

4. The second Immutable Circle is called the *Zodiack*, which is a great Oblique broad Circle, under which the Planets do alwaies move; the Poles of this Circle are distant from the Poles of the World 23 Degrees, 31 Minutes, and 30 Seconds, or 23 . 53 Centesms.

5. This Circle doth differ from other Circles in the Heavens, in that other Circles, to speak properly, have Longitude or Length, but no Breadth, whereas this Circle is allowed to have both.

[handwritten marginalia: in the Heavens — on Earth — at the Equinoxes]

[handwritten notes at bottom: extending in breadth about 20° i.e. 10° on each side the great C. In circle. This is done to take in the Orbits of the planets they all moving within that space: see more Art. 7.]

6. In refpect of Longitude, this Circle is divided as other Circles commonly are into 360 Degrees, but more peculiarly into 12 parts, conftituting, as it were, the 12 Parts or Months of the Year, or 12 Conftellations of Stars, called Signes, each Sign being fubdivided into 30 Degrees or Parts. The Names and Characters of thefe 12 Conftellations, or Signs, are as followeth. Aries ♈, Taurus ♉, Gemini ♊, Cancer ♋, Leo ♌, Virgo ♍, Libra ♎, Scorpio ♏, Sagittarius ♐, Capricornus ♑, Aquarius ♒, Pifces ♓,

7. The *Zodiack*, in refpect of Latitude, is divided into 16 Degrees, that is, into 8 Degrees North-ward, and 8 Degrees Southward, becaufe all the Planets, except the Sun, do in their Motions vary from the middle Line, fometimes one way, and fometimes another; to the quantity of 8 Degrees; and the middle Line in which the Sun moves, is the *Ecliptick* Line, becaufe when the Sun and Moon are in Conjunction, the Sun is Eclipfed, but when they are in Oppofition, the Moon is Eclipfed.

8. Of thefe 12 Signs, 4 are called Cardinals, viz. *Aries* and *Libra*, (in which do happen the Vernal and the Autumnal *Æquinoctials*;) *Cancer* and *Capricorn*, in which do happen the Summer and the Winter Solftices.

9. Again thefe Signs are diftinguifhed into Northern and Southern; the Northern Signs are thofe which decline from the Æquator towards the North Pole, as ♈, ♉, ♊, ♋, ♌, ♍; And the Southern Signs are thofe which decline from

from the Æquator towards the South Pole, as ♎, ♏, ♐, ♑, ♒, ♓.

10. All other Constellations of fixed Stars are referred to some one or other of the 12 Signs, whether they be the 21 Northern Constellations, called *Ursa Minor*, *Ursa Major*, *Draco*, *Cepheus*, *Arctophylax*, *Corona Borealis*, *Engonasus*, *Lyra*, *Avis*, *Cassiopeia*, *Persius*, *Heniochus*, *Serpentarius*, *Serpens*, *Sagitta*, *Aquila*, *Delphinus*, *Equisectio*, *Pegasus*, *Andromeda*, *Triangulus*.   Or whether they be the 15 Southern Constellations, called *Cetus*, *Orion*, *Eridanus*, *Lupus*, *Canis Major*, *Procyon*, *Argo*, *Hydra*, *Crater*, *Corvus*, *Centaurus*, *Fera*, *Ara*, *Corona Austr. Pisces Austra.*

11. The two other Great Circles called the *Colures*, are the two Circles which pass through the Poles of the World, and the four Cardinal points in the *Zodiack*. ♈ ♎, ♋ ♑.

12. That Circle which passeth through the Poles of the World, and the two Solstitial points in the Zodiack, which are the beginnings of ♋ and ♑, and is called the Solstitial Colure.

13. That Circle, which passeth through the Poles of the World and the two Æquinoctial points, or first entrance into ♈ and ♎, is called the *Æquinoctial Colure*, and in *Fig.* 9. represented by the line *DC*.

14. The Lesser Circles of the Sphere are the two Tropicks of ♋ and ♑ with the Artick and Antartick Circles.

15. The *Tropick* of ♋ is a Circle joyned
to

to the Zodiack in the beginning of ♋, and is described by the Suns Diurnal Motion, when he is in the Summers Solstitial point, and is distant from the Æquinoctial towards the North Pole 23 *deg.* 31′ 30″ or in Decimal Numbers, 23 *deg.* 5.25. to which when the Sun cometh, he causeth the longest Day and shortest Night to all Northern; the shortest Day and longest Night to all Southern Inhabitants; and is noted with *G* ♋.

16. The *Tropick* of ♑, is a Circle joyned to the Zodiack in the beginning of ♑, and described by the Suns Diurnal Motion, being in the Winters Solstitial point, and is distant from the Æquinoctial towards the South Pole, 23 *deg.* 31′ 30″, or in Decimal Numbers, 23 *deg.* 5.25 *parts,* to which, when the Sun cometh, he maketh the longest Day and shortest Night, to all Southern; the shortest Day and longest Night to all Northern Inhabitants, and is noted with *H* ♑.

These two Circles are called of the Greek Τροπικοι, *à convertendo,* because when the Sun toucheth any of the Circles, he is at his greatest distance from the Æquator, and returneth thither again.

17. The *Artick Circle,* is distant from the North Pole of the World, as much as the Tropick of ♋ is distant from the Æquinoctial, and is noted with *K L.*

The *Antartick Circle* is distant from the South Pole as much as the Tropick of ♑ is distant from the Æquator, and is noted with *O M.*

18. By

18. By the Intersection of any three of the greatest Circles of a Sphere is made a *Spherical Triangle*.

19. A *Spherical Triangle*, is either Right Angled or Oblique.

20. A *Right Angled Spherical Triangle*, hath one Right Angle at the least.

21. An *Oblique Angled Spherical Triangle*, is either Acute or Obtuse.

22. An *Acute Angled Spherical Triangle*, hath all its Angles Acute.

23. An *Obtuse Angled Sperical Triangle*, hath all his Angles, either Obtuse or mixt, that is, one Angle at the least Obtuse, and the other Acute.

24. In *Spherical Triangles*, there are 28 Varieties or Cases, 16 in *Rectangular*, and 12 in *Oblique Angular*, whereof all the *Rectangular* and 10 of the *Oblique Angular*, may be resolved by one Catholick, and Universal Proposition; for the understanding whereof, some things must be premised.

1. That in a *Right Angled Spherical Triangle*, the *Hypotenuse* and both the *Acute Angles* are supposed to be noted with their *Complements*.

2. That the *Right Angle* is not reckoned amongst the Circular parts, and therefore one of the other five will be always a middle part, and the other four extreams *Conjunct* or *Disjunct*.

The

The Proposition is this:

A Rectangle made of the Sine of the middle part and Radius, is equal to the Rectangle made of the Tangents of the Extreams Conjunct, or of the Cosines of the Extreams Disjunct: Therefore,

When two things are given, and a third required, you must first find out the middle part, and where the other Terms be Extreams Conjunct or Disjunct; if the things given and inquired lie together, the middle is the middle part, but if they be disjoined, that which standeth by it self is the middle part.

Note also, that when a Complement in the Proposition doth chance to concurr with a Complement in the Circular Parts, you must take the Sine it self, or the Tangent it self, because c s *of the* t s = *s*. *and* c t *of the* c t = t.

25. These things being understood, the Analogies to be used in every of the 16 Cases of a Right angled Triangle, will from this Proposition be as followeth.

Cons	Data	Quæs	Analogia.
1	BC A	AB	Rad cot . A :: t BC . s AB.
2	A AB	BC	cot A . Rad :: s AB . t BC.
3	AB BC	A	t BC . s AB :: Rad . ct A.

4. AB

4	AB A	AC	$t\,AB\,.\,cs\,A :: Rad\,.\,cot\,AC.$
5	AC AB	A	$R\,cot\,.\,AC :: t\,AB\,.\,cs\,A.$
6	AC A	AB	$cot\,AC\,.\,Rad :: cs\,A\,.\,t\,AB.$
7	AC C	AC	$Rad\,.\,ct\,C :: ct\,A\,.\,cs\,AC.$
8	AC A	C	$ct\,A\,.\,cs\,AC :: ct\,C.$
9	AC A	BC	$Rad\,.\,s\,A :: s\,AC\,.\,s\,BC.$
10	BC A	AC	$S\,A\,.\,s\,BC :: Rad\,.\,s\,AC.$
11	AC BC	A	$S\,AC\,.\,s\,BC :: Rad\,.\,s\,A.$
12	AB A	C	$Rad\,.\,s\,A :: cs\,AB\,.\,cs\,C.$
13	AB C	A	$cs\,AB\,.\,cs\,C :: Rad\,.\,s\,A.$
14	A C	AB	$s\,A\,.\,cs\,C :: Rad\,.\,cs\,AB.$

| 15 | AB BC | AC | $Rad\ cs\ AB :: cs\ BC\ .\ cs\ AC$ |

| 16 | AC AB | BC | $cs\ AB\ .\ cs\ AC :: Rad\ .\ cs\ BC$ |

26. In *Oblique angled Spherical Triangles*, there are, as hath been said, 12 Cases, 10 whereof may be resolved by the Catholick Proposition, if the Spherical Triangle propounded be first converted into two Right, which may be done by this General Rule.

From the end of a side given, being adjacent to an Angle given, let fall the Perpendicular.

A Type of the several varieties here followeth.

| 1. | AC CD D | A | $Rad\ .\ SCD :: sD\ .\ sBC$ $sAC\ .\ Rad :: sBC\ .\ sA$ |

| 2. | CD A D | AC | $sA\ .\ sD :: sCD\ .\ sAC$ |

| 3. | AC CD D | AD | $cot\ CD\ .\ R :: cs\ D\ .\ t\ BD$ $cos\ BD\ .\ cs\ CD :: R\ .\ cs\ BC$ $R\ .\ cs\ BC :: cs\ AC\ .\ cs\ AB$ $BD + AB = AD.\ 1\ Tri.$ $BD - AB = AD.\ 2\ Tri.$ |

4.	A C C D D	C	*ct D . Rad* ∷ *cs C D . ct BCD.* *ct CD . cs BCD* ∷ *R . t BC.* *R . t BC* ∷ *ct AC . cs ACB.* *BCD + ACB = ACD.* 1. Tri. *BCD — ACB = ACD.* 2. Tri.
5.	A D C A	C	*ct A . R* ∷ *cs AC . ct ACB.* *s ACB . cs C AB* ∷ *R . cs BC.* *cs BC . R* ∷ *cs BDC . cs BCD.* *ACB + BCD = ACD.* 1. Tri. *BCD — ACB = ACD.* 2. Tri.
6.	A D AC	A D	*ct . AC . R* ∷ *cs D AC . t AB.* *ct . DAC . R AB* ∷ *R . t BC.* *R . t BC* ∷ *ct ADC . s BD.* *AB + B D = AD.* 1. Tri. *BD — AB = AD.* 2. Tri.
7.	A A A C	D	*ct . C AB . R* ∷ *cs AC . ct ACB.* *ACD — ACB = BCD.* 1. Tri. *ACD + ACB = BCD.* 2. Tri. *s ACB . cs CAB* ∷ *R . cs BC.* *R . cs BC* ∷ *s BCD . cs CDB.*
8.	A C AC	DC	*ct CAB . R* ∷ *cs AC . ct ACB.* *ACD — ACB = BCD.* 1. Tri. *ACD + ACB — BCD.* 2. Tri. *ct AC . cs ACB* ∷ *R . t BC.* *t BC . Rad.* ∷ *cs BCD . ct DC*

9.	AD AC A	D C	ct AC . R :: cs CAD . t AB. $AD - AB = BD$. 1. Tri. $AD + AB = BD$. 2. Tri. cs AB . cs AC :: R . cs BC. R . cs BC :: cs BD . cs DC.
10	AC AD A	C	ct AD . R :: cs CAD . t AE. $AE - AC = CF$ in 1. Tri. $AE + AC = CF$ 2. Tri. ct CAD . s AE :: R . t DF. t DF . R :: s CF . ct DCF.
11	$\left. \begin{matrix} AC \\ AD \\ DC \end{matrix} \right\}$	C	$\left\{ \begin{matrix} s\,AC * s\,CD . \text{Rad. square.} \\ s\frac{1}{2}z - AC * s\frac{1}{2}z - CD. \\ Q . s^{\perp} C. \end{matrix} \right.$

The Twelfth, is but the Converfe of the laft, taking the Angles for Sides, and the Sides for Angles; fo fhall the Angle found, be the Side inquired.

CHAP. III.

Of the Ascensions and Descensions of the Parts of the Zodiack.

Hitherto we have spoken of the general Principles of *Astronomie*, from whence the motion of the *Primum Mobile* is explained; come we now to these affections which properly belong to the motion thereof, and these are the Ascension and Descension of the Parts of the Zodiack, or Astronomical Rising and Setting.

2. *Astronomical Rising and Setting*, is the Elevation of the parts of the Zodiack or Ecliptick above the Horizon, and Depressed under it, compared to the Ascension and Descension of the parts of the Æquator; and this comparison is in reference to diverse Elevations of the Poles.

3. But this Astronomical Rising and Setting, takes his Denomination from the parts of the Zodiack; which are above the Horizon or beneath it, and are Measured with respect unto the Æquator; for Astronomers do not refer the Æquator to the Zodiack, but the Zodiack to the Æquator, for it is the Zodiack, and not the Æquator which stands in need of Measuring.

4. And an Arch of the Ecliptick or Zodiack, is to be understood two manner of wayes; namely, *Continued* or *Discrete*; A *Continued*

Arch,

Arch, is when it is reckoned in the Æquator in a Continued Series, from the beginning of Aries, and so forward into the consequent Signs.

5. A *Discrete Arch*, is so called, because it is not reckoned from the first Degree of *Aries*, but from any other Point; as from the fourteenth of *Gemini*, to the fourteenth of *Taurus*.

6. Any part of the Zodiack is then said to Ascend Right, when a greater part of the Æquator riseth above the Horizon than of the Zodiack. And that is said to be a greater Arch of the Æquator, which is more than 90 Degrees.

7. Any part of the Zodiack is then said to Descend Right, when a greater part of the Æquator than of the Zodiack is beneath the Horizon.

8. Any part of the Zodiack therefore is said to Ascend Obliquely, when a less part of the Æquator than of the Zodiack doth Ascend; as also, to Descend Obliquely, when less of the Æquator than of the Zodiack is below the Horizon.

9. *Ascension*, is either Right or Oblique.

10. *Right Ascension* or *Descension*, is that which is in a Right Sphere.

11. In a Right Sphere, the four Quadrants of the Zodiack beginning from the Æquinoctial and Solstitial Points, do equally Ascend and Descend, so that in these whole Quadrants, as many Degrees of the Æquator as of the Zodiack do Ascend; but the intermediate parts

of

of thofe Quadrants in the Zodiack do vary, and have not equal Afcenfion and Defcenfion with the parts of the Æquator. *Which caufes a difference in ye meafurement of time called the Equation of time*

12. Thofe Signs that are equally diftant from any of thofe Points, have alfo equal Afcenfion, as *Gemini* and *Cancer*. And the Afcenfion of a Sign is alwaies equal to the Defcenfion of the fame.

13. In a Right Sphere therefore, four Signs only do rife Right, all the reft do rife Obliquely.

14. In an Oblique Sphere, the two halves that begin at the two Æquinoctial Points, do rife together, but the parts of thofe halves do rife Obliquely. And thofe Signs that rife Rightly, do Defcend Obliquely, and the contrary.

15. The Afcenfion of oppofite Signs in an Oblique Sphere, taken together, are equal to the Afcenfion of the fame in a Right Sphere. And thofe Signs that are equally diftant from either of the Æquinoctial Points, have equal Afcenfions, becaufe they equally Decline from the Æquator.

16. Befides the Aftronomical Rifing and Setting of the Stars, or their Rifing and Setting, in refpect of the Horizon and Æquator, there are other affections of the Stars to be confidered, namely, thofe which they have in refpect of the Sun.

17. In refpect of the Celeftial Circles, that is in refpect of the Zodiack, Æquator, and Horizon, there is a fourfold affection of the
                                                          Stars.

Stars. 1. *Longitude.* 2. Of *Altitude.* 3. Of *Latitude.* 4. Of *Declination.*

18. The *Longitude* of a Star is his diftance from the firft Degree or Point of *Aries*, accounting from Weft to Eaft.

19. The *Altitude* of a Star is to be confidered Generally or Specially. Generally confidered, the Altitude of a Star is the height thereof above the Circle of the Horizon.

20. Specially confidered, the Elevation of the Pole Star above the Horizon, is called the Altitude.

21. The *Latitude* of a Star is his Diftance from the Ecliptick, that is from the very middle of the Zodiack towards either Pole, whether North or South.

22. The *Declination* of a Star, is his Diftance from the Æquator, and as he declines from thence either Northward or Southward, fo is his Declination nominated either North or South.

23. Thus much of thefe affections of the Stars, which they have in refpect of the Celeftial Circles; come we now to thofe which they have in refpect of the Sun; ufually called the Poetical Rifing and Setting; and this is threefold. The firft of thefe in *Latin*, is called *Ortus Matutinus five Cofmicus*, The Morning or Cofmical Rifing. The fecond, *Vefpertinus five Achronicus*, The Evening or Achronical; and the laft, *Heliacus vel Solaris*, Heliacal or Solary.

24. The Cofmical or Morning Rifing of a Star,

Star, is when it Riseth above the Horizon, together with the Sun.   And the Cosmical or Morning Setting of a Star is, when it Setteth at the opposite part of Heaven, when the Sun Riseth.

25. The *Achronical*, or Evening Rising of a Star, is when it Riseth on the opposite part, when the Sun Setteth; And the Achronical Evening Setting of a Star, is when it Setteth at the same time with the Sun.

26. The *Heliacal* Rising of a Star, which you may properly call the Emersion of it, is when a Star that was hid by the Sun Beams, beginneth to recover it self out, and to appear. And so likewise, the Setting of such a Star, which may be also called the Occultation of the same, is when the Sun by his own proper Motion overtaketh any Star, and by the brightness of his Beams doth make it invisible unto us.

And thus having briefly shewed the chief affections of the *Primum Mobile*; how the quantity of these affections may be computed, by the Doctrine of Spherical Triangles, shall be declared in the Problems following.

Problem I.

To find the Suns Greatest Declination and the Poles Elevation.

In *Fig. 9.* *A Z, P N* represents the Meridian, *E F* the Æquinoctial, *H R* the Zodiack, *P* the
North

North Pole; *O*, the South; *A B*, the Horizon; *Z*, the Zenith; *N*, the Nadir; *HC*, a Parallel of the Suns Diurnal Motion at *H*, or the Suns greateſt Declination from the Æquator towards the North Pole; *R Q*, a Parallel of the Suns greateſt Declination from the Æquator towards the South Pole. From whence it is apparent, that from *A* to *H*, is the Suns greateſt Meridian Altitude, from *A* to *Q*, his leaſt; if therefore you deduct *A Q*, the leaſt Meridian Altitude, from *A H*, the greateſt, the Difference will be *H Q*, the Suns greateſt Declination on both ſides the Æquator; and becauſe the Angles *E D H*, and *F D R*, are equal, therefore the Suns greateſt Declination towards the South Pole is equal to his greateſt Declination towards the North, and conſequently, half the Diſtance of the Tropicks; that is, *E Q*, or *E H*, is the quantity of the Suns greateſt Declination; and then if you deduct the Suns greateſt Declination, or the Arch *H E*, from the Suns greateſt Meridian Altitude, or the Arch *A H*, the Difference will be *A E*, the height of the Æquator above the Horizon, the Complement whereof to a Quadrant, is the Arch *A O* equal to *B P*, the height of the Pole.

Example.

The Suns greateſt Meridian Altitude, taken *June* the Eleventh at *London* ──── ──── ── } 61.99167

The Suns leaſt Meridian Altitude *December* the Tenth ——— } 14.94167

Their Difference is the Diſtance of the Tropicks ——— ——— } 47.05000

Half that is the Suns greateſt Declination, whiſe Difference is the Suns greateſt, is ——— } 23.52500

The Elevation of the Æquator, and the Complement thereof to 90, is the Elevation of the Pole —— } 38.46667
51.53333 *or Latitude of the place.*

Problem II.

The Suns greateſt Declination being given, to find his Declination in any point of the Ecliptick.

In *Fig.* 9. In the Right Angled Spherical Triangle *G L D*, we have given the Suns greateſt Declination *G D L*, and the Suns Diſtance from the next Æquinoctial point *L D*, to find the preſent Declination *G L*, for which the Proportion is *Rad . s L D :: s D . s G L.*

Problem III.

The Suns greateſt Declination and his Diſtance from the next Equinoctial point given, to find his Right Aſcenſion.

In *Fig.* 9. In the Right Spherical Triangle *G D L*, we have given as before the Angle *G D L*, and the Hypotenuſe *D L*, to find the

the Suns Right Ascension DG; the Proportion is Rad. $ct DL :: cs D . t DG$.

Problem IV.

The Elevation of the Pole, and Declination of the Sun being given, to find his Amplitude.

In *Fig.* 9. In the Right Angled Spherical Triangle DTV, we have given the Complement of the Poles Elevation or Angle VDT, and the Suns Declination VT, to find DT, the Suns Amplitude; for which the Proportion is; $s VDT . Rad. :: s VT . s DT$.

Problem V.

The Poles Elevation and Suns Declination being given, to find the Ascensional Difference.

In *Fig.* 9. In the Right Angled Spherical Triangle DVT, we have given the Complement of the Poles Elevation or Angle VDT, and Suns Declination VT, to find the Ascensional Difference DV; the Proportion is, $t VDT . Rad. :: t VT . s DV$.

Problem VI.

The Right Ascension, and Ascensional Difference being given, to find the Oblique Ascension and Declination.

In *Fig.* 9. *G V*, represents the Right Ascension; *D V*, the Ascensional Difference; *G D*, the Oblique Ascension, which is found by Deducting the Ascensional Difference *D V*, from the Right Ascension *G V*; for if the Declination be North,

Add ⎱ The Ascensional Difference ⎱ ⎰ Asc.
     ⎰ to or from the Right Ascen. ⎰ Obl. ⎱
Sub. ⎱ and it will give ⎱ ⎰ Desc.

If the Declination be South,

Sub. ⎱ The Ascensional Diff. to ⎱ ⎰ Ascen.
     ⎰ or from the right Ascen. ⎱ Obl. ⎰
Add ⎱ and it will give ⎱ ⎰ Desce.

Problem VII.

To find the time of the Suns Rising and Setting, with the Length of the Day and Night.

First find the Ascensional Difference, as hath been shewed in the Fifth Problem; which, when the Sun is in the Northern Signs, is to be added to the Semi-diurnal Arch of the Right Sphere,
which

which is 90, but is to be Subtracted from the same, if he be in the Southern Signs, and the Sum or Difference will be the Semi-diurnal Arch, which doubled, is the Day Arch, whose Complement to 24, is the Night Arch, which Bisected, is the time of the Suns Rising.

Problem VIII.

Latitude

The Poles Elevation, and the Suns Declination given, to find the time when he will be due East and West.

In *Fig.* 10. In the Right Angled Spherical Triangle *T P Z*, we have given *P Z*, the Complement of the Poles Elevation, and *T P*, the Complement of the Suns Declination, to find the Angle *T P Z*, for which the Proportion is, *Rad. . t P Z :: ct T P . cs T P Z.* whose Complement to a Quadrant *T P D*, being converted into time, sheweth how much it is after six in the Morning, when the Sun will be due East, and before six at Night, when he will be due West.

Problem IX.

Latitude

The Poles Elevation, with the Suns Altitude and Declination given, to find the Suns Azimuth.

In *Fig.* 10. In the Oblique Angled Spherical

rical Triangle *S P Z*, we have given *S P* the Complement of the Suns Declination, *P Z* the Complement of the Poles Elevation, and *S Z* the Complement of the Suns Altitude, to find the Angle *S Z P*, the Suns Azimuth from the North; for which by the eleventh Caſe of Oblique Angled ſpherical Triangles, the Proportion is; As the Rectangle of the Sines of *S Z*, and *Z P*, is to the Square of Radius, ſo the Rectangle made of Sines of the Differences of thoſe containing ſides and half ſum of three ſides given, to the Square of the ſine of the half Angle inquired.

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CHAP. IV.

Of the Secundary or Periodical Motion of the Stars.

HAving done with the first part of *Astronomy*, the Motion of the *Primum Mobile*, and the Affections of the Stars, occasioned by that Motion; we are now to speak of their own Proper or Periodical Motion, in which, contrary to the Motion of the *Primum Mobile*, they are carried from West to East.

2. This Motion of the fixed Stars is very flow; for they alter their places but little in many Years, but are not immoveable as some thought; the quantity of their Annual Motion, according to *Tycho Brahe* is 50 seconds, and 37 Thirds of a Degree, and others since him do conceive that 50 seconds only is the quantity of their Annual Motion, that is most agreeable unto truth and observation.

3. This Motion in the Planets is more swift, and although they never move out of the Zodiack, yet they do move sometimes in one part of Heaven, sometimes in another, sometimes towards the South Pole, sometimes towards the North, sometimes near one fixed star, sometimes near another, and sometimes nearer, sometimes farther from one another also, whereas the fixed stars do always keep the same distance from one another.

4. The Planets do not all move in one Orb, but

but every Planet hath a several Orb, whereas the infinite number of fixed stars do all move in one only Sphere or Orb.

5. The Names and Characters of the Planets are these: *The Herschel whose mark is ♅ revolves round the ☉ in 83 years & 2 inpore.*

1. *Saturn*, whose mark is ♄, finisheth his Revolution in 29 Years, 174 Dayes, 4 Hours. *has 7 moons*

2. *Jupiter*, whose mark is ♃, finisheth his Revolution in 11 Years, 317 Dayes, 15 Hours. *has 4 moons*

3. *Mars*, whose mark is ♂, finisheth his Revolution in 1 Year, 321 Dayes, 23 Hours.

4. The *Earth* or *Sun*, marked thus ☉, finisheth his Course in 365 Dayes, 5 Hours, 49 Minutes, 4 seconds, and 21 thirds. *has only one moon*

5. The *Moon*, marked thus ☾, finisheth her Course in 27 Dayes, 7 Hours, 43 Minutes, and 6 seconds, but returneth not into Conjunction with the *Sun*, under 29 Dayes, 12 Hours, 44 Minutes, and 3 seconds.

6. *Venus*, marked thus ♀, finisheth her Course in 224 Dayes, 16 Hours, 40′ and 30″.

7. *Mercury*, marked thus ☿, finisheth his Course in 87 Dayes, 23 Hours, 00′ and 15″.

6. The Civil Year, though it doth not exactly agree, yet hath it some proportion with the Motions of the Sun and Moon in every Nation; *Romulus* the Founder of *Rome*, appointed the Year at first to consist of 10 Moons, or Months, and called the first *March*; 2. *April*, 3. *May*, 4. *June*, the rest *Quintilis, Sextilis, September, October, November, December*, be-

caufe they were 5, 6, 7, 8, 9, and 10 Months diftant from *March*.

After whom, *Numa Pompilius*, added two Months more, and called them *January* and *February*, and appointed each Month to contain 29 and 30 Days, whereby the Year did confift of 354 Days, in which time the Moon returneth into Conjunction with the Sun, and this is the quantity of the Year in *Turky* at this Day, only in every third Year, they reckon 355 Days. The *Perfians* and *Ægyptians* count 12 Moons or Months to their Year, but their Months are proportioned to the time of the Suns continuance in every of the 12 Signs; In their Year therefore, which is folar, there are always 365 Days, that is, 11 Days more than the Lunar Year.

And the *Julian* Year, which is the Accompt of all *Chriftendom*, doth differ from the other only in this, that by reafon of the Suns excefs in Motion above 365 Days, which is about 5 Hours, 49 Minutes, it hath a Day Intercalated once in four Years, and by reafon of this Intercalation, it is more agreeable with the Motion of the Sun, the former differing from the *Numan* Year, 11 Days and 6 Hours, the which 11 Days, *Julius Cæfar* diftributed amongft the Months, and the Month *Quintilis*, was by him called *July*, according to his own name; and *Auguftus Cæfar* called the Month *Sextilis*, by the name of *Auguft*, and altered the Pofition of Days in each Month to that which we now ufe, in which there are 52 Weeks, and one odd Day, and

and this one Day supernumerary., maketh an alteration in all the reft, so that the Days of the Week, which ufed to be affigned by the Letters of the Alphabet, fall not alike in feveral Years; but *Sunday* this Year, muft fall out upon the next Years *Monday*, and so forward, till seven Years; and becaufe the fix odd Hours do make a Day in four Years, every fourth Year hath a Day added to its accompt, and fuch a Year doth confift of 366 Days, which doth occafion the *Sunday* letter ftill to alter till four times 7, that is, 28 Years be gone about. This Revolution is called the *Cycle* of the Sun, taking name from ☉, *Sunday*, the Letter whereof it doth appoint for every year, as by the Table may be feen.

To find which of 28 the prefent is, add 9 to the Year of Our Lord, becaufe this Circle was so far gone about at the time of *Chrift's birth*, divide the whole by 28, what remains, is the prefent Year; if nothing remain, the *Cycle* is out, and that Year you muft call the laft, or 28.

This Intercalation of a Day, placed in *February*, doth occafion the letter *F* to be twice repeated in the latter end of that Month, *viz.* upon the 24 and 25 Days, and in fuch a Year St. *Matthias* Day is to be obferved upon the 25. of that Month, and the very next *Sunday* doth change and alter his letter, from which Leaping or Changing, fuch a Year is called the *Leap Year*, and the Number of Days

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in each Month is well expressed in these Distichs.

> *Thirty Days hath* September,
> April, June, *and* November;
> February *hath Twenty eight alone;*
> *All the rest hath Thirty and one:*
> —— *But when of Leap Year cometh the time,*
> *Then Days hath* February *Twenty and Nine.*

That this Accompt is somewhat too long, is acknowledged and confessed by the most skilful *Astronomers*, as for the Number of Days in a Year, the Emperour's Mathematicians were in the right, for it is certain, no Year can consist of more than 365 Days, but for the odd Hours, it is as certain that they cannot be fewer than five, nor so many as six, so that the doubt is upon the Minutes, sixty whereof goeth to the making of an Hour; a small matter one would think, and how great in the recess and consequence we shall see.

Julius Cæsar alotted 365 Days, 6 Hours, to his Revolution; but the Sun goeth about in less time, that is, (according to the most exact accompt,) in 365 Days, 5 Hours, 49 Minutes, and a little more; so that the Emperours Year must of necessity breed a difference in so many Minutes every Year, betwixt the Year which the Sun it self describes in the Zodiack, and that which is reckoned upon in the Calender, which though for a Year or two may pass insensibly, yet in the space of 134 Years it will

rise to a whole Day, that is, the beginning of
the Year in the Calender must be set one day
back.

As for Example:

Let the Year begin in the Vernal Æquinox,
or Spring, in the Emperours time, that fell out
to be the 24th of *March*, but now this Year it
fell out the 10th of *March*, 13 Days backward
and somewhat more; and so if it be let alone,
will go back to the first of *March*, and first of
February, till *Easter* come to be on *Christmas-
day*, and so infinitely.

To reform this difference in the accompt,
some of the latter *Roman* Bishops earnestly en-
deavoured, and the thing was brought to that
perfection it now standeth, (so much as it is,)
by *Gregory* the Thirteenth, in the Year 1582.
his Mathematicians, (whereof *Lylius* was the
chief) advised him thus : That considering
there had been an agitation in the Council of
Nice, somewhat concerned in this matter upon
the Motion of the Question about the Celebra-
tion of *Easter*; And that the Fathers of that
Assembly, after due deliberation with the Astro-
nomers of that time, had fixed the Vernal
Æquinox; at the 21th of *March*, and conside-
ring also, that since that time a difference of 10
whole Days had been past over in the Calender,
that is, that the Vernal Equinox or Spring,
which began upon the 21th of *March*, had pre-
vented so much as to begin in *Gregories* days,
at the 10th of the same, 10 Days difference, or
thereabout; they advised, that 10 Days should

be cut off from the Calender, which was done, and the 10 Days taken out of *October*, in the Year 1582, as being the Month of that Year in which the Pope was born, so that when they came to the 5*th* of the Month, they reckoned the 15*th*, and so the Æquinox was come up to its place again, and happened upon the 21*th* of *March*, as at the Council of *Nice*. But that *Lylius* should bring back the beginning of the Year to the time of the *Nicene* Council, and no further is to be marvelled at; he should have brought it back to the Emperours own time, where the mistake was first entred; and instead of 10, cut off 13 Days; however this is the reason why these two Calenders differ the space of 10 Days one from another.

And thus I have given you an accompt of the Year as it now stands with us in *England*, and with the rest of the *Christian* World, in respect of the Sun; some other particulars there are with us and them, that do depend upon the Motion of the Moon, for the better understanding of them, I will give you a brief accompt of her Revolution.

The Solar Year consisting, as hath been said, of 11 Days more than the Lunar Year; those 11 Days called the Epact, are therefore added to the Lunar Year, to make it equal with the Solar, by the addition of which excess, in every three Years there is gotten a number more than 30, but because the Moon, between Change and Change doth never pass 30 Days, the Epact cannot exceed that number, and the

...ne in which the Moon is suppofed to make
...r feveral Motions, and fo return to the place
...here fhe firft began, is a Circle or Revolution
...f 19 Years, firft found out by *Meton*, an *Athe-*
...*ian*, who lived about 439 Years before Chrift,
...is Cycle is therefore called *Cyclus Decenno-*
...*ennalis*, and from the *Aufbr Annus Metonicus*,
...om whofe *Athenians*, the *Ægyptians* may feem
...o have received it, as the *Romans* from them,
...n Letters of Gold, from whence (if not
...rom the more precious ufe of it) it attained
...o be called, as yet ftill it is, the *Numerus An-*
...*nus*, or Golden Number: It is made *Chriftian*,
...y the Fathers of the *Nicene* Council, as being
...altogether neceffary to the finding out of the
Neomenea Pafchalis, upon which the Feaft of
Eafter and all the reft of the Moveable Feafts
depend: It felf is found by adding an Unit to
the Year of our Lord, and Dividing the whole
by 19, the Remainder fhall be the Cycle of the
Moon, or if nothing remain, the Cycle is out,
that is, 19.

And the Epact is found by Multiplying the
Golden Number by 11, and Dividing the Pro-
duct by 30, what Remains is the Epact; but to
fave this trouble of Calculation, you have it fet
down to your hand in the Table before the Ca-
lender, the ufe whereof as of the Golden
Number is to find the Change of the Moon,
for the Ancient Philofophers fuppofing the
Moon to make a Perfect Revolution in 19 Years,
did Calculate the feveral Changings of the
Moon that happened in each Month for that
                                                      time,

time, and placed the Golden Number for each Year, right against the day of the Month on which the Moon changed, that so having found the Golden Number, they might thereby presently know on what day of the Month the Moon did Change, in any Month of the Year for ever, as also the time, when the Feast of *Easter* was to be observed, according to the Canon made at a General Council held at *Nice*, in the Year of our Lord, 322, in which it is commanded that *Easter* should be Celebrated upon the next *Sunday* following the first Full Moon after the Vernal Æquinox, which then was upon the 21*th* day of *March*, and according to this Rule is this Feast observed with us at this day, and not according to the true Motion of the Moon, or precise time of the Vernal Æquinox, which now is about the 10*th* of *March*; This use of the Golden Number is well expressed in these Distichs.

In March *after the first* C,
Look the Prime *where e're it be*;
The third Sunday *after* Easter-*day shall be*,
And if the Prime *on the* Sunday *be*,
Then reckon that for one of the three.

To find the New Moons by the Epact, do thus, To the Epact for the Year given, add the Number of the Months from *March* including both Months, and the Days of that Month past, the Sum of these three Numbers shall give you the age of the Moon, if they exceed

not

not 30, if more than 30, cast away 30, and the Remainder shall be the Age as before.

Example.

I would know the Age of the Moon on the Fifteenth day of *August*, 1672. the Epact is 11, and the Months from *March* to *August* are 6, and 15 the day of the Month, all which put together, do make 32, from whence take 30, and there rests 2, the Age of the Moon that day.

And to know the day of the Change, do thus: To the Epact add all the Months from *March*, and if they joyned together, come not to 30, look what they lack of 30, and at so many days of the Month the Moon changeth: If they be above 30, and the Month you desire have 31 days, then Subtract 30; but if 30 days, then Subtract 29, and that rest take from 30, then look what remains, and at so many days of the Month the Moon Changeth, by either of these ways the time of the New Moons may indeed be guest at, but not exactly found: How that may be done, is shewed in the larger Treatises of this Subject; this we deem sufficient for our present purpose.

A Table,

A Table, shewing the Cycle of the Suns, Dominical Letter, Golden Number, and the Epact.

Year of our Lord	Year of our Lord	Cycl. ☉	Dom. Lett.	Year of our Lord	Year of our Lord	Year of our Lord	Golden Number	Epact
1784	1672	1	GF	1700				
85	1673	2	E	1701				
86	1674	3	D	1702				
87	1675	4	C	1703	1710	1672	1	11
88	1676	5	BA	1704	1711	1673	2	22
89	1677	6	G	1705	1712	1674	3	3
1790	1678	7	F	1706	1713	1675	4	14
1	1679	8	E	1707	1714	1676	5	25
2	1680	9	DC	1708	1715	1677	6	6
3	1681	10	B	1709	1716	1678	7	17
4	1682	11	A	1710	1717	1679	8	28
5	1683	12	G	1711	1718	1680	9	9
6	1684	13	FE	1711	1719	1681	10	20
7	1685	14	D	1713	1720	1682	11	21
8	1686	15	C	1714	1721	1683	12	12
9	1687	16	B	1715	1722	1684	13	23
1800	1688	17	AG	1716	1723	1685	14	4
1	1689	18	F	1717	1724	1686	15	15
2	1690	19	E	1718	1725	1687	16	26
3	1691	20	D	1719	1726	1688	17	7
4	1692	21	CB	1720	1727	1689	18	18
5	1693	22	A	1721	1728	1690	19	29
6	1694	23	G	1722				
7	1695	24	F	1723				
8	1696	25	ED	1724				
9	1697	26	C	1725				
1810	1698	27	B	1725				
1	1699	28	A	1727				

	January.		February.		March.	
1	3 a	Circum.	d		3 d	David.
2	b		11 e	Purifica.	e	
3	11 c		19 f		11 f	
4	d		8 g		g	
5	19 e		a		19 a	
6	8 f	Epipha.	16 b		8 b	
7	g		5 a		c	
8	16 a		11 d		16 d	
9	5 b		13 e		5 e	
10	c		2 f		f	
11	13 d		g		13 g	
12	2 e		10 a		2 a	
13	f		b		b	
14	10 g		c	Valent.	10 c	
15	a		18 d		d	
16	18 b		7 e		18 e	
17	7 c		f		7 f	
18	d		15 g		g	
19	15 e		4 a		15 a	
20	4 f		b		4 b	
21	g		12 c		c	
22	12 a		1 d		12 d	
23	1 b		e		1 e	
24	c		5 f		f	
25	9 d		17 g	S. Math.	9 g	Annun.
26	e		a		a	
27	17 f		6 b		17 b	
28	6 g		14 c		6 c	
29	d				d	
30	13 b				14 e	
31	3 c				3 f	

	October.		November.		December.
1	16 a		d All Sain.		f
2	5 b		13 e		13 g
3	13 c		2 f		2 a
4	2 d		g		10 b
5	e		10 a		c
6	10 f		b		18 d
7	g		18 c		7 e
8	18 a		7 d		f
9	7 b		e		15 g
10	c		15 f		4 a
11	15 d		4 g		b
12	4 e		a		12 c
13	f		12 b		1 d
14	12 g		1 c		e
15	1 a		d		9 f
16	b		9 e		g
17	9 c		f		17 a
18	d		17 g		6 b
19	17 e		6 a		c
20	6 f		b		14 d
21	g		14 c		3 e S. Tho.
22	14 a		3 d		f
23	3 b		e		11 g
24	c		11 f		a
25	11 d		19 g		19 b Christm.
26	e		a		8 c S.Steven.
27	19 f		8 b		d S. John.
28	3 g Simon &		c		16 e Innocen.
29	e Jude.		16 d		5 f
20	16 b		5 e Andrew.		g
31	5 c				13 a

THE ENGLISH ACADEMY:

The SIXTH PART.

OF RHETORICK.

CHAP. I.

Of the Definition and Parts of RHETORICK.

RHETORICK, is the Art or faculty of eloquent and delightful Speaking.

The Parts of *Rhetorick* are Five; *Invention, Disposition, Elocution, Memory,* and *Pronunciation.*

In *Invention,* we are to consider three things: 1. What we are to Invent. 2. By what Arguments we may confirm the Matter Invented. 3. From what Topicks or general Heads those Arguments may be raised.

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	April.	May.	June.
1	*g*	11 *b* Philip &	*e*
2	11 *a*	*c* Jacob.	19 *f*
3	*b*	19 *d*	8 *g*
4	19 *c*	8 *e*	16 *a*
5	8 *d*	*f*	5 *b*
6	16 *e*	16 *g*	*e*
7	5 *f*	5 *a*	13 *d*
8	*g*	*b*	2 *e*
9	13 *a*	13 *c*	*f*
10	2 *b*	2 *d*	10 *g*
11	*c*	*e*	*a*
12	10 *d*	10 *f*	18 *b*
13	*e*	*g*	7 *c*
14	18 *f*	18 *a*	*d*
15	7 *g*	7 *b*	15 *e*
16	*a*	*c*	4 *f*
17	15 *b*	15 *d*	*g*
18	4 *c*	4 *e*	12 *a*
19	*d*	*f*	1 *b*
20	12 *e*	12 *g*	*c*
21	1 *f*	1 *a*	9 *d*
22	*g*	*b*	*e*
23	9 *a*	9 *c*	17 *f*
24	*b*	*d*	6 *g* Jo. Bapt.
25	17 *c* S. Mark.	17 *e*	*a*
26	6 *d*	6 *f*	14 *b*
27	*e*	*g*	3 *c*
28	14 *f*	14 *a*	*d*
29	3 *g*	3 *b*	11 *e* Pet. Ap.
20	*a*	*c*	*f*
31		11 *d*	

	July.	August.	September.
1	19 g	8 c Lammas.	16 f
2	8 a	16 d	5 g
3	b	5 e	a
4	16 c	f	13 b
5	5 d	13 g.	2 c
6	e	2 a	d
7	13 f	b	10 e
8	2 g	10 c	18 f
9	a	d	7 g
10	10 b	18 e	a
11	c	7 f	15 b
12	18 d	g	4 c
13	7 e	15 a	d
14	f	4 b	12 e
15	15 g	c	1 f
16	4 a	12 d	g
17	b	1 e	9 a
18	12 c	f	b
19	1 d	9 g	17 c
20	e	a	6 d
21	9 f	17 b	e S. Matt.
22	g	6 c	14 f
23	17 a	d	3 g
24	6 b	14 e S. Bar	a
25	c Jam. Ap.	3 f tholo.	11 b
26	13 d	g	19 c
27	3 e	11 a	d
28	f	b	8 e
29	11 g	19 c	f S.Mich.
30	a	8 d	g
31	19 b	e	

	April		May		June
1		g	11 b	Philip &	a
2	11	a	c	Jacob.	19 f
3		b	19 d		8 g
4	19	c	8 e		16 a
5	8	d	f		5 b
6	16	e	16 g		c
7	5	f	5 a		13 d
8		g	b		2 e
9	13	a	13 c		f
10	2	b	2 d		10 g
11		c	e		a
12	10	d	10 f		18 b
13		e	g		7 c
14	18	f	18 a		d
15	7	g	7 b		15 e
16		a	c		4 f
17	15	b	15 d		g
18	4	c	4 e		12 a
19		d	f		1 b
20	12	e	12 g		c
21	1	f	1 a		9 d
22		g	b		e
23	9	a	9 c		17 f
24		b	d		6 g Jo. Bapt.
25	17	c S. Mark	17 e		a
26	6	d	6 f		14 b
27		e	g		3 c
28	14	f	14 a		d
29	3	g	3 b		11 e Pet. Ap.
20		a	c		f
31			11 d		

	July.		August.		September.
1	19 g		8 c Lammas.		16 f
2	8 a		16 d		5 g
3	b		5 e		a
4	16 c		f		13 b
5	5 d		13 g		2 c
6	e		2 a		d
7	13 f		b		10 e
8	2 g		10 c		18 f
9	a		d		7 g
10	10 b		18 e		a
11	c		7 f		15 b
12	18 d		g		4 c
13	7 e		15 a		d
14	f		4 b		12 e
15	15 g		c		1 f
16	4 a		12 d		g
17	b		1 e		9 a
18	12 c		f		b
19	1 d		9 g		17 c
20	e		a		6 d
21	9 f		17 b		e S. Matt.
22	g		6 c		14 f
23	17 a		d		3 g
24	6 b		14 e S. Bar-		a
25	c Jam. Ap.		3 f tholo.		11 b
26	13 d		g		19 c
27	3 e		11 a		d
28	f		b		8 e
29	11 g		19 c		f S. Mich.
30	a		8 d		g
31	19 b		e		

	October.	November.	December.
1	16 a	d All Sain.	f
2	5 b	13 e	13 g
3	13 c	2 f	2 a
4	2 d	g	10 b
5	e	10 a	c
6	10 f	b	18 d
7	g	18 c	7 e
8	18 a	7 d	f
9	7 b	e	15 g
10	c	15 f	4 a
11	15 d	4 g	b
12	4 e	a	12 c
13	f	12 b	1 d
14	12 g	1 c	e
15	1 a	d	9 f
16	b	9 e	g
17	9 c	f	17 a
18	d	17 g	6 b
19	17 e	6 a	c
20	6 f	b	14 d
21	g	14 c	3 e S. Tho.
22	14 a	3 d	f
23	3 b	e	11 g
24	c	11 f	a
25	11 d	19 g	19 b Christm.
26	e	a	8 c S. Steven.
27	19 f	8 b	d S. John.
28	3 g Simon &	c	16 e Innocen.
29	e Jude.	16 d	5 f
30	16 b	5 e Andrew.	g
31	5 c		13 a

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CHAP. I.

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The Parts of *Rhetorick* are Five; *Invention, Disposition, Elocution, Memory,* and *Pronunciation*.

In *Invention*, we are to consider three things: 1. What we are to Invent. 2. By what Arguments we may confirm the Matter Invented. 3. From what Topicks or general Heads those Arguments may be raised.

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And first, the thing or matter which we are to invent, is the scope and purpose of the intended Oration: That is, we must propound some certain Proposition to which we mean to direct our Speech; and of those several Propositions which may be raised from the subject propounded, we should still make choice of that which is most agreeable to the Sentence given.

Secondly, When we have resolved upon a Proposition, we are to bethink our selves of some Arguments or probable Reasons, by which that Proposition may be confirmed.

Thirdly, We are to consider the several Topicks or common places from whence these probable Arguments may be invented and raised, and these are of two sorts; *Intrinsecall* and *Extrinsecal*; those are called *Intrinsecal*, which are comprised in the matter which is propounded, and the Topicks or Heads, from whence such Arguments may be invented, are these following.

1. *Definition.*　2. *Division.*　3. *Notation.* 4. *Conjugation.*　5. *Genus.*　6. *Species.*　7. *Similitude.*　8. *Dissimilitude.*　9. *Contraries.* 10. *Opposites.*　11. *Comparison.*　12. *Causes.* 13. *Effects.*　14. *Adjuncts.*　15. *Antecedents.* 16. *Consequents.*　All other *Topicks*, from whence Intrinsecal or Artificial Arguments may be raised, are contained in these, or may be derived from them.

1. *Definition*, is a Speech explaining or declaring what a thing is; The parts whereof, according

according to Logicians are two ; 1. The *Genus* ,
or general name agreeing with the thing defi-
ned , and with several other things besides.
2. The difference or particular name, which
doth only agree with that which is defined :

For Example:

Man is a Living Creature, endued with Rea-
son. In which the *Genus* is Living Creature ;
and this agrees with other Creatures besides
Man; The Difference, is endued with Reason,
and this is proper to Man only. But such De-
finitions as these, are seldome used by Orators ,
but such rather as are called Descriptions, more
properly than Definitions; as when a thing is
described by its parts , or by its effects', or by
the causes by which effects are produced, and
such like.

2. *Division*, is the distribution of the matter
propounded into its parts; Thus the Life of
Man may be divided into Infancy, Child-hood ,
Youth, Middle-age, Old-age.

3. *Notation*, or *Etymologie*, is the Interpre-
tation of a Word, shewing as well the Original
thereof, as the Signification; As a *Senate* is so
called from the convention of the Seniors or
Old Men.

4. *Conjugation*, is either when one Word
hath various endings ; as *knife, knives*; or when
several Words do come from one Primitive ,
thus ; *beautiful* and *beautifulness*, are both deri-
ved from *beauty*.

5. A *Genus* , is that which comprehends se-

veral

veral things under it; which are really different from one another.

6. A *Species*, is that which may with other things be referred to one common *Genus*: And thus this Word *Art*, is a *genus*, in respect of the seven Liberal Sciences; as *Grammar*; *Rhetorick*, &c. and these Sciences, *Grammar*, *Rhetorick*, &c. are the Forms and *Species* which are contained under this *Genus* or general term, *Art*.

7. *Similitude*, is the comparing of two or more things together, which are in themselves divers, but do agree in some particular.

For Example.

A *shadow* and *glory*, are in themselves very different things; but yet they agree in this, that the *shadow* doth accompany the *body*, and *glory*, *virtue*.

8. *Dissimilitude*, is the disagreeing of two or more things in some particular.

9. *Contraries*, are such things which cannot both at the same time, agree with one and the same thing: Thus no man can be said to be Wise in that thing in which he is a Fool.

10. *Opposites*, are such things as can never agree together, as *wrath* and *friendship*.

11. *Comparison*, is the comparing of one thing with another? This is either equal or unequal.

Equal Comparison is, when two equal things are compared together; as thus, *He hath deceived thee, therefore he will deceive me also.*

Unequal

Unequal Comparison, is two ways, first, when we argue from the greater to the less: As *God spared not the Angels that sinned, how then shall he spare Man?*

Secondly, when we argue from the less to the greater, As, *He will not let one sin go unpunished; much more will he therefore punish a multitude of sins.*

12. *Causes,* are such things by which any thing is in any sort produced; there are Four sorts of *Causes; Efficient, Material, Formal,* and *Final.*

The *Efficient cause,* is that which maketh a thing: Thus the Sun causeth or maketh the day.

The *Material cause,* is that of which a thing is made, as *Money,* of *Gold* and *Silver,* &c.

The *Formal cause,* is that by which the thing is what it is, or that by which it is distinguished from other things; Thus a *Ship* and a *Timber-house* do differ in the form, or divers disposing of the parts.

The *Final cause,* is that for which a thing is made.

13. *Effects,* are such things as are propounded by their Causes.

14. *Adjuncts,* are such things which are joyned to the thing or person propounded, but not of necessity; and these are usually seven.

Quis? Quid? Ubi? Quibus Auxiliis? Cur? Quomodo? Quando:

In English thus,

*First ask, Who? What? and Where? and Then,
What aid? with Why? and How? and When?*

Quis?

Quis ? Who ? doth fignifie the quality of the Perfon, in which there muft be confidered his Nature, Sex, Age, Nation, Kindred, and Eftate, in refpect of his Body, Mind, and Fortune.

Quid ? What ? importeth an Inquiry after the nature of a thing, as whether it be of importance or not; whether great or fmall; noble or ignoble.

Ubi ? Where ? denotes the place.

Quibus Auxiliis ? With what aid ? notes an inquiry concerning the perfon that joyned with him in that action, or other Inftruments by which it is effected.

Cur ? Why ? denotes the final caufe, with what intent, or to what end it was done.

Quomodo ? How ? fhews the manner of doing it; as namely, with eafe, or how hardly.

Quando ? When ? notes the time in which it was done, and this head doth many times afford great plenty of matter.

15. *Antecedents,* are fuch things which go before the thing or matter; as you made him tremble, therefore he is fenfible.

16. *Confequents,* are fuch things which do neceffary follow after the thing or matter; as He that is thruft through the heart, muft needs die; thefe are the Intrinfecal or Artificial *Topicks,* from whence Arguments may be raifed on any Theme or matter propounded in this manner:

Every Theme or Propofition doth confift of three parts; a *Subject,* a *Predicate,* and a *Copula.*

That is called the *Subject,* of which we fpeak;

The

The *Predicate*, is that which is spoken of the Subject; and the *Copula*, is some Verb, which joyns the Subject with the Predicate, as in this Proposition ; Claudius *laid snares for* Milo : *Claudius* is the Subject, because it is of him that we are to speak. *Snares for* Milo, is the Predicate; because that is the thing which is said of *Claudius.* And the Verb *laid*, is the Copula, which joyns the Subject with the Predicate. Now then if you will find out Arguments on this Proposition, take the Subject, and go through every Topick : First go to Definition, and ask What it is? What is the nature of it ? and How it is distinguished from other things ? Then go to Division, and see into how many parts the Subject may be divided; and so forward from Topick to Topick. And still observe to your self every Argument, which doth by this means arise from the Subject, and apply it to the Predicate; so shall you easily see, whether it doth fully confirm your Proposition; and when you have done with the Subject, take the Predicate, and run through the several Topicks with that also; but if the mattter require it, and that you judge it more convenient to take the whole Proposition, then the Subject and Predicate apart by themselves, you may in that manner run through all the heads of Invention; but stay not too long upon any one, for if matter offer not it self in one head, go to another, for every head perhaps may not afford matter, at least not such as is apt and fit. But if you would know

L 4   whether

whether your Arguments or matter be drawn from the Subject, or from the Predicate, put it into the form of a Syllogism, and if the major be most certain, you may conclude, that the Argument is drawn from the Predicate; but if the minor be most certain, it is then drawn from the Subject.

When you have found the Arguments which prove the Proposition, you must reduce them into the form of a Syllogism, which doth consist of three Propositions: The first whereof is called the *Major*, the second the *Minor*, and the third the *Conclusion* or *Inference*.

For Example:

In the former Proposition, Claudius *laid snares for* Milo; the Matter or Subject of the Discourse may be drawn from the Predicate, *the snares laid for* Milo; which being a treacherous thing, every one may naturally infer, that it doth deserve punishment.

Now then joyn this Inference with the Predicate of your Proposition; saying, *He that layeth snares deserveth punishment*, and this is your *Major*; then take the Subject of your Proposition, and joyn that with the Predicate, and say, Claudius *layeth snares*, and that is your *Minor*: From both which, this conclusion must needs follow, *Therefore* Claudius *deserveth punishment*.

17. Hitherto we have spoken of Artificial Arguments, Inartificial are either Testimonies or Examples.

Testimonies are either Divine or Humane,

a

a Divine Testimony, is that which hath God for its Author ; such are the Oracles of God, and the predictions of his Prophets.

Humane Testimony, is either Common or Proper.

Common Testimony, is that which depends either upon some Law, Custom, or Opinion and Sayings of Wise Men.

Proper Testimony, is that which is peculiar to some particular Causes.

Example, is an Inartificial Argument, by which the Truth of a Thing is confirmed and illustrated.

CHAP.

CHAP. II.

Of Disposition.

Disposition, is the orderly placing of those things which are invented : It is two fold.

First, *Natural*, in which things are discoursed in that order in which they were done, or in which according to Nature, they should be done ; as if you were to commend a Person, you should begin with his Child-hood, next his Youth, and so to the other degrees of his Age.

The second way is *Artificial*, which doth either for delight or profit diversly mingle and confound the matter, putting that in the end, which should be in the beginning, and the beginning in the end, that so he may both delight the Auditors, and hold them in suspense ; which in an unexpected event doth not a little please and delight the Hearers.

The Orator then having resolved of his Proposition, must first consider of what nature it is, whether single, or consisting of several parts ; and which of the parts should be first handled, which next.

Secondly, he must chose some few of the best Arguments he hath invented, and place some solid Argument in the beginning, those that are less forcible in the midst, reserving still the best and most convincing for the conclusion ;

lusion; becaufe the Auditor at the firft being greedy of knowing, muft be prepoffeffed and convinced; but in the end he muft be ftrongly confirmed and forced.

And the moft perfwafive Arguments are thofe which proceed from the Definition, Diftribution, *Genus*, Caufes, and Effects of the thing difcourfed of, for thefe explain the nature thereof; and lefs forcible Arguments are fuch as are collected from fome trivial Adjuncts and Conjectures.

Thirdly, he muft Logically difpofe of thefe Reafons and Arguments; Firft, into Syllogifms, and then confider how to enlarge them in an Oratorical manner.

Fourthly, he muft confider into what parts his Oration fhould be divided, and the parts of an Oration are ufually reckoned to be thefe five.

1. *Exordium.*   3. *Narration.*
2. *Propofition.*   4. *Confirmation.*
5. *Peroration*, or *Conclufion.*

As for Confutation, it is comprifed in Confirmation: But all thefe parts are not always neceffary; for the ingenious Orator, may as he fhall fee it convenient, fometimes omit the *Narration*, fometimes the *Exordium*, fometimes the *Peroration* or *Conclufion*, yea, and the *Confirmation* is many times fcarce difcernable; as when the things propounded are certain, there is more need of Ornament than Proof, as in

Gratu-

Gratulatory Orations, and the like. As for the placing of thefe parts, their natural Order is that in which we have named them. 1. The *Exordium*. 2. The *Propofition*. 3. The *Narration*, if it be not thought fit to omit it. 4. The *Confirmation*; and Laftly, The *Peroration*.

An *Exordium*, is as it were the door of the Oration, in which the Orator doth prepare the minds of the Auditor for that which is to follow: And this is commonly done by one of thefe three ways; By befpeaking their Favour; by making them Docible; or by begging their Attention. The Favour of the Auditors is befpoke either from the perfon of the Orator, from the perfons of the Auditors, from the perfons of the Adverfaries, or from the fubject matter of the Difcourfe. The Orator may befpeak the Favour of the Auditors, in refpect of himfelf, if his gefture and deportment be fuitable unto theirs that are his Auditors, and exprefs himfelf modeftly. And in refpect of the Auditors, if he fhew how well they have deferved of the Common-wealth, of him, and other men. And in refpect of the Adverfaries, if he modeftly fhew wherein they are faulty, and render them to the Auditors inexcufable. And laftly, in refpect of the matter in hand, if he fay, that it is fome excellent, neceffary, and profitable thing.

Secondly, the Orator may be faid to make the Auditors Docible, if he clearly explain the thing of which he is to fpeak, and how he purpofeth to enlarge upon it.   Thirdly,

Thirdly, the Attention will be quickened, if he faith, that he intends to fpeak of fome great and wonderful thing, and fomething that is delightful, neceffary, and very much concerns his Auditors, &c.

The fecond part of an Oration is the *Propofition*; And the *Propofition* is that part of the Oration, in which the Orator doth briefly deliver the fum of the whole Matter of which he intends to fpeak, and befpeaks the Hearers Attention if need be. Sometimes it doth immediately follow the *Exordium*; fometimes it follows the *Narration*; in what place foever it be put, it muft be fhort and clear, and fit for *Confirmation*.

The third part of an Oration is *Narration*, by which a relation is made of the matter or thing done. And this is either a diftinct part of the Oration, and then for the moft part it doth immediately follow the *Exordium*, that the *Propofition* with the *Confirmation*, which is to be done in fuch Orations which affume the explanation of the thing done to prove the matter in hand:

For Example :

If you were to prove that fome Valiant Perfon had been a Souldier in fome Warr; it is neceffary that you fhould delare what the particular Actions were in which he fhewed his Valour.

But now in that *Narration*, which is made a diftinct part of the Oration; the thing done muft be briefly and fimply declared without any

exaggre-

exaggregation: And in such a *Narration* as makes way for *Confirmation*, the things done may be illustrated with great neatness of Language, with Sentences and Figures, and some Discourses may be made concerning the worthiness of the action, with some amplification from Similitudes and Comparisons.

The fourth part of an Oration, is *Confirmation*; and *Confirmation* is as it were the very Heart and Soul by which an Oration may be chiefly said to Live: Or it is the chief part of an Oration in which the Arguments are produced, by which we would prove our *Proposition*, and refute or answer the contrary opinion of our Adversary, if need require. What is necessary in this behalf, may be collected from what hath been already said. Seeing that *Confirmation* doth consist of the Arguments that are invented, and the right disposition of them, both which have been fully enough declared before.

Confutation, is a part or kind of *Confirmation*, in which we Answer all Objections; it doth either precede or follow *Confirmation*, or may be here or there used in all the parts of the Oration.

And these objections may be either all Answered together, or those first which are first made, and then the latter; or those first which are most material, and the rest may fall of themselves; or the weakest first, that they being avoided, the strongest Arguments may be somewhat weak'ned. And the manner of doing this,

this, is by shewing, that the Adversaries Alle-gation is either false, impossible, uncertain, or impertinent, and the like.

Peroration, or *Conclusion*, is the last part of an Oration, in which the Orator should very much endeavour to set an edge in the minds of his Auditors, and incline them to be of his side; and here he should therefore use such Figures, as are most proper to move the Affections: It doth chiefly consist of two parts, *Enumeration*, and *Amplification*.

Enumeration is required, that the chief Arguments more largely opened in the former discourse may be clearly repeated in a new form of words.

Amplification, desires that this repetition may be made, by some serious expressions, adorned with Sentences and Figures.

CHAP.

CHAP. III.

Of Elocution.

ELocution, or the garnishing of Speech, is an Art by which the Speech is beautified with the elegancy of Words and Sentences.

And this is performed two ways; by the fine manners of Words, called a *Trope*; or by the fine frame of Speech, called a Figure.

A *Trope* is such an Elocution or manner of Speech, as doth change the signification of a word into a different signification from the natural.

In a *Trope* two things are to be considered.

1. The *Affections*. 2. The *Kinds*.

The *Affections* of a *Trope* are four, { Catachresis. Hyperbole. Matalepsis. Allegoria.

Catachresis, is a harsh and unpleasant change of a Word; as namely, when one Word or Name is put for another, not by any proper relation, but by a kind of force. *He threatens me a good turn.*

Hyperbole, is a very high relation of a thing, or a more bold excess of a *Trope*, which doth exceed belief, either by Augmentation or by Diminution. Note that though an *Hyperbole*
                                                                              doth

doth vary from the truth, yet doth it not deceive us through Fiction, or such variation.

An *Hyperbole* is two fold; *Auxesis* or *Meiosis*.

An *Auxesis* is, when for Argumentation sake or Amplification, we interpose a more vehement expression, in his proper place; as when we say, *magnificent* for *liberal*.

A *Meiosis*, or a *Tapinosis*, is when for extenuation sake, we use a milder or more favourable expression, than the matter requireth; as when we say *a flatterer is a courteous and an affible person*.

A *Metalepsis*, is that which containeth many Tropes in one expression; as, when we by an improper Speech, signifie, first, that which is improper, and by that improper Speech perhaps another, and so forward, till we come to that which is proper, making way for Transition, by interposing a mean degree; as *All the City was moved, Mat.* 21. 10. where the City is put for *Jerusalem*, by a *Synechdoche Generis*: and *Jerusalem* for its Inhabitants, by a Metonymy of the Subject.

An *Allegory*, is the continuation of a Trope, as where many Tropes of the same kind are joyned together; as, *Put on the whole Armour of God. Ephesians* 6. 11.

In an *Allegory*, observe to end with the same kind of Trope with which you begin, or else the Consequence will be abused.

The several kinds of Tropes as these four:
1. A *Metonomy*.   3. A *Metaphor*: and
2. An *Irony*.   4. A *Synechdoche*.

M   A Me-

A *Metonomy*, is a Trope of the Cause to the Effect, of the Subject to the Adjunct: and the contrary, of the Effect to the Cause, or of the Adjunct to the Subject.

There are four kinds of Causes.

1. The *Efficient Cause*, by which a thing is.

2. The *Material Cause*, of which a thing is made.

3. The *Formal Cause*, by which a thing is what it is.

4. The *Final Cause*, for which a thing is; of which the two first only belong to our present purpose.

A *Metonymy* of the *Cause*, is of the *Efficient*, or of the *Matter*.

A *Metonymy* of the *Efficient cause*, is when the Author or Inventor of any thing is put for those things which he hath invented; as *Virgil*, for the Poem or Works composed by *Virgil*.

A *Metonymy* of the *Material Cause*, is when the name of the Matter is put for the Effect; as Brass, for Brass Money.

A *Metonymy* of the *Effect*, is when the Efficient Cause is signified by the Effect; as, *Pale Death, which maketh Pale.*

A *Metonymy* of the *Subject*, is when the proper name of any Subject is made to signifie the Adjunct; as, *the Cup*, for the *Drink in the Cup.*

A *Metonymy* of the *Adjunct*, is when the Adjunct is put for the Subject; as *Gen.* 31. 53. *Jacob Sware by the fear of his Father Isaac*, i. e. by God, whom *Isaac* feared.

An

An *Irony*, is a Trope from one oppofite to another, or in which we fpeak by contraries.

Oppofites, are either unlike or contrary, all things of different natures are faid to be unlike; as a *Man*, a *Stone*, and all things of contrary natures are faid to be contrary to one another; as *light* and *darknefs*.

An *Irony* of a thing unlike, is when any thing is fpoken of one perfon, and underftood of another.

An *Irony* from the contrary, is when one contrary is fignified by another; as *O thou haft done very well*; meaning that he had *done very ill*.

Paralepfis, is a kind of *Irony*, by which we feem to pafs by, or take no notice of fuch things which yet we ftrictly obferve and remember.

Apophafis; is a kind of *Irony*, by which we deny to fay or do what yet we fpeak with greateft earneftnefs, and do with all our might.

A *Metaphor*, is a Trope, by which we exprefs our felves by a word, which is of the like fignification with that we mean; as, *the King is the head of the Common-wealth*.

Synecdoche, is a Trope, by which a part is put for the whole, or the whole for a part.

A Part, is either a Member or Species.

A *Synecdoche* of a Member, when by a Member the whole is fignified; as, the *Roof*, for the *Houfe*.

A *Synecdoche* of the *Species*, is when the *Species* is put for the *Genus*; as, *Crœfus*, for a *Rich man*.

The whole is either an *Integer* or *Genus*.

A

A *Synecdoche* of an *Integer*, is when an *Integer* is put for a Member; as, *His Army was so great, that it drank the Rivers dry*; meaning a great part of the Water in the River.

A *Synecdoche* of the *Genus* is, when the general is put for the fpecial; as, *Preach the Gospel to every Creature*, meaning Mankind only, and not to every Creature.

Hitherto of *Tropes*, the firft kind of elocution, the fecond kind of Elocution by Figure.

CHAP. IV.

Of a Figure.

A *Figure*, is a kind of Elocution , by which the form of a Speech is changed from its right and plain use.

A *Figure*, is either of a Word, or of a Sentence.

A *Figure of a Word*, is that by which an Oration or Speech is composed of Words aptly and sweetly suitable to one another, and this consists in the Dimension or Repetition of Sounds or Words.

A *Figure* , in the Dimension of Sounds , is the sweet number of Sounds in a Sentence.

Number , is either *Poetical* or *Oratorical.*

A *Poetical Number,* is that which is confined to a perpetual observation of certain Spaces.

A *Number Poetical* , is either *Rhyme* or *Meter.*

Rhyme is a *Poetical Number ,* containing a certain number of Feet , without any regard to the quantity of the Syllables , whether long or short As,

Dare to be true ; nothing can need a lye :
A fault that needs it most, grows two thereby.

A *Meter*, is a Poetical Number, consisting of certain Feet, of which the last Foot hath the last Syllable indifferent or common ; that is , long or short.

Oratorical Number doth indeed consist of Feet, but not of any certain number of Feet, but of as many or as few as the Orator pleaseth.

The *Figure* of a Word in respect of the repetition thereof, is either of like or unlike Sounds.

A *Figure* of a Word in the repetition of the like Sound, is either with, or without intermission.

Repetition of the like Sound without intermission, is either an *Epizeuxis*, or an *Anadiplosis*.

An *Epizeuxis*, is when a like Sound is repeated in the same Sentence without intermission; as, *a Sword, a Sword is sharpened.*

An *Anadiplosis*, is when a like Sound without Intermission is repeated in divers Sentences, *i.e.* when it ends one and begins another; as,

> *If then, why I take not my leave, she ask;*
> *Ask her again, why she did not unmask?*

Repetition of like sound with intermission in the same place, is either an *Anaphora* or *Epistrophe*.

An *Anaphora*, is when a like sound is repeated in the beginning of Sentences; as,

> *By art of Sails and Oars, Seas are divided:*
> *By art the Chariot runs; by art Love's guided.*

An *Epistrophe*, is when a like sound is repeated, in the close of Sentences; as, *Are they Hebrews? so am I: Are they Israelites? so am I*

Are

Are they of the seed of Abraham? *so am I.*

Repetition of like sound with intermission in divers parts or places, is either an *Epanalepsis*, or an *Epanados*.

An *Epanalepsis*, is when a like Sound is repeated in the beginning and ending of the same Sentence; as, *In sorrow was I born, and I must dye in sorrow.*

An *Epanados*, is when the like Sound is in the beginning and ending of divers Sentences, an *Anadiplosis* coming between; as, *Parthenia desired above all things to have* Argalus; Argalus *feared nothing but to miss* Parthenia.

A *Figure* of a Word made by the repetition of Sounds somewhat unlike, is either *Paronomasia*, or *Polyptoton.*

Paronomasia, is when a Word being changed in a Letter or Syllable, it is also changed in Sense and Signification; as, *Though you advise me to repent, I have not Grace to follow your advice.*

A *Polyptoton*, is when Words of the same Original are reiterated, but with some variation; as, *Deceiving*, and *being Deceived.*

A *Figure* in reference to a Sentence, is a Figure which affecteth the whole Sentence with some motion of the Mind, either in absolute reasoning, or in reasoning Dialogue-wise.

Logismus, or absolute Reasoning, is when a Sentence is composed without any talking with other supposed; this is either *Ecphonesis*, a recalling of ones self, *Apostrophe*, or *Prosopopeia.*

Ecphonesis, is a Figure in reasoning, by way of Exclamation, by an Adverb expressed, or

under-

underſtood ; as, *O wretched man that I am!*

Recalling of ones ſelf , is when ſomething is called back ; and it is as it were a Diminution of the over-haſtineſs or heat of Speech ; and this is either *Epanorthoſis*, or *Apoſiopeſis*.

An *Eparnorthoſis* , is when ſomething preceeding is called back, by correcting it ; as, *I had one only Young Man to my Son ; ah! what have I ſaid! I had! Yea I had! It is now uncertain whether I have or not.*

An *Apoſiopeſis*, is when the cloſe of a Sentence begun is ſtopped , by keeping in a part, which yet is underſtood ; as, *You Rogue, if I Live!*

An *Apoſtrophe* , is when a Speech is directed to another , than was by the Speech it ſelf at firſt intended ; as, *God knows I lye not!*

A *Proſopopæia*, is when in our Oration, we ſuppoſe another perſon to be ſpeaking; as, Joſh. 24. 27. *Behold this ſhall be a witneſs unto us ; for it hath heard all the Words of the Lord, which he hath ſpoken unto us.*

A *Figure* , in reaſoning Dialogue-wiſe , is when a Sentence is compoſed in form of a Conference ; this conſiſteth in Queſtion and Anſwer , in Conſenting or diſſenting Dialogiſm.

A *Figure* of conſenting Dialogiſm , is when ones Anſwer doth admit of the Objection expreſſed or underſtood ; yet ſo , as that from thence the inconſequence of the Objection may be ſhewed if need be.

Diſſenting Dialogiſm , is when ones Anſwer doth impugn or croſs the Objection.

And thus much concerning *Elocution*, as for *Memory* and *Pronunciation*, which are the other two parts of *Rhetorick*, I purposely omit them, as being natural Endowments, which may be better improved by constant practice, than by any Precepts which can be given.

F I N I S.

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as being natural Endowments, which may be
better improved by constant practice, than by
any Precept which can be given.

FINIS.

THE *ENGLISH* ACADEMY:

The SEVENTH PART.

Of the ART of LOGICK.

CHAP. I.

Of Simple Themes.

Logick, is an Art which conducteth the Mind in the knowledge of Things.

2. The Parts of *Logick* are two *Thematical* and *Organical*.

3. The *Thematical* part is that, which Treateth of Themes, with their various affections, and second Notions, as of the matter of which Logical Instruments are composed.

4. The *Organical* part, is that which Treateth of these Instruments, and their Composition.

5. A *Theme*, is any thing propounded to the understanding, that it may be known.

6. A

6. A *Theme* , is either *Simple* or *Compound.*

7. A *Simple Theme*, is one Voice, Signifying one thing; as, *a Man, a Horse.*

8. A *Compound Theme*, is a Theme made of several Simple Themes rightly joyned together; signifying many or several things; such are all Orations.

9. A *Simple Theme or Voice* , is

1. *Concrete*, which expresseth a thing Concretely or Jointly ; as, *Learned.*

2. *Abstract* , which noteth something Abstracted from all others; as, *Learning.*

10. An *Abstract Voice*, or Simple Theme, is Singular or Universal.

11. A *Singular Theme*, is that which in its own nature can be spoken of no more than one , and is called an Individual.

12. *Individuals* are of two sorts.

1. Such as are Certain and Determinate; as, *this man, Paul, Alexander, the Apostle of the Gentiles,* &c.

2. Such as are uncertain and indeterminate, as *some man.*

13. An *Universal Simple Theme* , otherwise called a Predicable , is that which may be spoken of many ; as, *a Body* ; and this is either of the First or Second Intention.

14. A *Simple Theme of the first Intention* , is that which expresseth the thing it self; as, *Gold, Stone,* &c. so called, because they are the names by which the things themselves are first made known.

15. A *Simple Theme of the second Intention* , is
that

that which doth not expreſs the things it ſelf but certain affections agreeing to the thing, and ſuch are all Words of Art; as, *a Noun*, *a Metaphor*, &c.

16. An *Univerſal Simple Theme*, may be ſpoken of many, two ways.

1. *In Quid?* or by declaring what a thing is; and thus it is ſpoken of ſuch as do differ in the *Species*, and is called *Genus*; as, *a living Creature*, *colour*, &c. or elſe of ſuch as do differ in number only, and is called *Species*; as, *a Man*.

2. *In Quale*, or by declaring what a kind of thing it is, of which it is ſpoken; and that Eſſentially or Accidentally, Eſſentially, and then it is called Difference, the which is,

1. *Diviſive*, by which a *Genus* is divided into its ſeveral *Species*, as by rational and irrational a Living Creature is divided into a Man or a Beaſt.

2. *Conſtitution*, which doth Eſſentially conſtitute ſome *Species*, and this is,

1. *Generical*, which doth conſtitute ſome remote *Species*, but not the next, for the next is the *Genus*; thus Senſibility in reſpect of Man, is a Generical difference, conſtituting firſt a living Creature, and then a Man. And this is always ſpoken of many differing in *Species*, or Number.

2. *Specifical*, which doth conſtitute the neareſt *Species*; as, Rationalibility doth conſtitute Man.

2. *Accidentally*, and that either of neceſſity, and then it is called a proper Accident, which

is

is convertible with its *Species*, perpetually inherent in every of them, and in no other, as the visible faculty in a Man.

Or not of necessity, and then it is called a common or simple Accident; not convertible with its *Species*; as *white*.

17. All *Simple Themes*, may be reduced to ten ranks or orders, called *Predicaments*, of which some are more principal, some less.

18. The more principal Predicaments are the first six, the less principal, are the other four.

19. The *Predicamental Ranks* or *Orders*, are of two sorts, the one of *Substance*, and the other of *Accidents*.

20. Of *Substance*, there is only one, and it is called by that name *Substance*, which is a thing subsisting of it self, and it is either first or second.

21. The first *Substance*, is a Singular Substance, or a Substance that cannot be predicated of its Subject; as, *Alexander*.

22. The second *Substance* is an Universal Substance, or a Substance which may be predicated of its Subject; as, *a Man*, *a Horse*. The first Substance is chiefly and properly a Substance, and among the second Substances, every one is by so much more a Substance, by how much it is nearer to the first.

23. The *Predicamental Ranks* or *Orders* of Accidents, are of two sorts.

1. *Absolute*, as the Predicaments of *Quantity*, *Quality*, *Action*, and *Passion*.

2. *Re-*

2. *Relative*, as the Predicament of *Relation*.

24. *Quantity*, is an abſolute accident, by which a thing is ſaid to be great in bulk or number.

25. *Quality*, is an abſolute Accident, by which it is Simply and Determinately declared what kind of thing, that ſubjeſt is, of which it is the *Quality*.

26. *Action*, is an Accident, by which a Subjeſt is ſaid to be doing.

27. *Paſſion*, is an Accident, by which the Subjeſt is called Patient; or it is the reception of *Action*.

28. *Relation*, is a reſpective Accident, by which one thing is predicated of another, or may by ſome way be referred unto another.

29. The leſs principal Predicaments are theſe four; *When, Where, Situation*, and *Habit*.

30. The Predicament *When*, is an Accident, by which finite things are ſaid to be in time, paſt, preſent, or to come.

31. The Predicament *Where*, is an Accident, by which things finite, are ſaid to be in ſome place.

32. The Predicament of *Situation*, is a certain Ordination, or placing of parts in Generation.

33. The Predicament of Habit, is an Accident, by which ſome Garment or ſomething like a Garment, is put about, hanged upon, or ſome way or other joyned to a Body.

CHAP.

CHAP. II.

Of Compounded Themes.

Hitherto of *Simple Themes : Compounded Themes*, or such as are made of several Simple Themes are next to be considered; otherwise called *Enunciations*, or *Propositions.*

2. An *Enunciation*, or *Proposition*, is an Indicative, Congruent and perfect Oration, signifying true or false without any Ambiguity.

3. The parts of a Proposition are two, the parts Signing or Signed.

4. The parts Signing are *Simple Terms*, whose parts can signifie nothing, being separated from the whole, or no such thing as they did signifie being joyned all together.

5. These *Simple Terms* are of two sorts , *Categorematical,* or *Syncategorematical.*

6. *Categorematical* , or Significative Terms, or such Simple Terms, as do by themselves signifie something perfectly; and these are either *Nouns* or *Verbs.*

7. A *Noun*, is a Simple Term or Word, which doth signifie some certain thing without destinction of time; as, *a man, a horse.*

8. A *Verb*, is a Simple Term, which doth signifie something, with some destinction of time past, present, or to come; as, *he runneth.*

9. *Syncategorematical* , or Consignificative Terms, are Simple Terms, which of themselves

do

do not signifie any certain thing, or constitute a Proposition, but being joyned with other Words, are significative, to express the manner of such a thing; and such are all Words which serve to express the quantity of a proposition; as, *all, none, some, &c.* with all Adverbs, Conjunctions, Prepositions, and Interjections.

10. The parts signed are three; the *Subject*, the *Predicate*, and the *Copula.*

11. The *Subject* is all that which precedes the *Copula* in the Proposition.

12. The *Predicate*, is all that which is spoken of the *Subject.*

13. The *Copula*, is the principal Verb, joyning the *Predicate* to the *Subject*, and in every Proposition is some person of this Verb Substantive, as in this Proposition, *A Man is a living Creature*; *a Man* is the *Subject*; *a living Creature* is the *Predicate*; and the *Verb is* the *Copula*; sometimes the *Copula* is some Person of a Verb Adjective; as in this Proposition, *Socrates lived at Athens.*

Here note, That the *Subject* doth not always Precede, and the *Predicate* follow the *Copula*, in order of the Parts or Terms, but in Sense and Construction; and also, that in some Propositions, the three Terms are not alwayes exprest, but implyed; as, *I walk, for I am walking.*

14. *Propositions* are distinguished three ways, according to *Substance, Quantity,* and *Quality.*

15. A *Proposition,* in respect of the Substance

or parts of which it doth confift, is either *Categorical* or *Hypothetial*.

16. A *Categorical Propofition*, is that which doth confift of one *Subject*, one *Predicate*, and one *Copula*; as, *a man is a Living Creature*, and this is either *Pure* or *Modal*.

17. A *Pure Categorical Propofition*, is when the *Predicate* is purely affirmed or denyed of the *Subject*, without expreffing the manner of affirming or denying.

18. A *Modal Categorical Propofition*, is when befides the *Subject*, *Predicate*, and *Copula*, we add fome modification, to fhew how the *Predicate* is in the *Subject*; as, *it is neceffary*; *it is contingent*; *it is poffible*; *it is impoffible that a man fhould be without reafon.*

19. An *Hypothetial Propofition*, is that which doth confift of two *Categorical Propofitions*, joyned together by fome Conjunction, as, *if a Man be a Living Creature, then a. Man is a Body.*

20. A *Propofition*, in refpect of *Quality*, is diftinguifhed two ways; firft, according to the *Quality* of the Sign, and fo it is Affirmative or Negative: Secondly, according to the *Quantity* of the thing; and fo it is either True or Falfe.

21. A *Propofition*, in refpect of *Quantity*, is, *univerfal, particular, indefinite*, or *fingular.*

22. An *Univerfal Propofition*, is that which hath a note of Univerfality added to a common or univerfal Subject; as, *every Man is a Living Creature.*

23. A *Particular Propofition*, is that in which
a note

a note of particularity is added to an universal Subject ; as, *Some Man is a Living Creature.*

24. An *Indefinite Proposition,* is that, in which no note, whether Universal or Particular is put before the universal Subject ; as, *a Man is a Living Creature.*

25. A *Singular Proposition,* is that in which the Subject is singular, whether it be a proper Name ; as, *Socrates is a Philosopher* ; or whether it be a common Name, with a note of singularity set before it ; as, *this Man is Learned.*

26. *Pure Categorical Propositions,* as they have reference to one another, haue three affections ; *Opposition,* *Æquipollency,* and *Conversion.*

27. *Opposition,* is the repugnancy of two *Categorical Propositions,* either in *quantity* alone, or in *quality* alone, or else in *quantity* and *quality* both, in which there is the same *Subject,* the same *Predicate,* and the same *Copula* ; as, *every Man is just, no Man is just.*

28. The *Categorical Propositions,* may be said to be Opposite four wayes ; *Contrarily, Subcontrarily, Subalternately,* and *Contradictorily.*

29. Two *Propositions,* that are *contrarily,* and *subcontrarily* opposite, are opposite only in *quality* ; and such as are *subalternately* opposite, are opposite only in *quantity* ; and such as are *contradictorily* opposite, are opposite both in *quantity* and *quality.*

30. *Opposition,* by way of Contrariety, is the repugnancy of two Universal Propositions in quality ; as, *every Man doth run, no man doth run* ;

and these in a contingent matter, may be both False, but cannot be both together True.

31. *Subcontrary Opposition*, is the repugnancy of two particular Propositions in *quality*; as, *some man doth run, some man doth not run*; and these in a contingent matter may be both True, but cannot be both together False.

32. *Subalternate Opposition*, is the repugnancy of two Affirmative, or two Negative Propositions in their *quantity*; as, *every man doth run, some man doth run.*

33. *Contradictory Opposition*, is the repugnancy of two Propositions, both in *quality* and in *quantity*; so that if one of them be Affirmative, the other shall be Negative; if one be Universal, the other shall be Particular; as, *Every Man is Learned, some Man is not Learned:* All which may be easily apprehended by the following Scheme.

Every man is learned.   *No man is learned*
<div align="center">Contrariety</div>
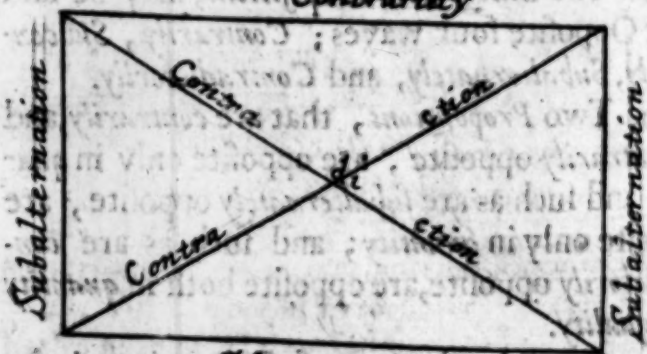
<div align="center">Subcontrariety</div>

Some man is learned.   *Some man is not learned*

34.

34. *Æquipollency* , is the equivalency of two Propositions, in *sense* and *signification*, though they differ in Words , by virtue of this Word of Negation (*not*) being set before the Sign and Subject , after the Sign and Subject , or both before and after , in which there is the same *Subject* , and the same *Predicate* ; as , *some man is Learned*; *not every man is Learned:* The several varieties whereof are fully expressed in these Distichs.

> If after Sign and Subject, this (not) be ,
> Contraries then, make Æquipollencie.
> Only before make contradictories ,
> But 'fore and aft', are subalternate guise.

35. *Conversion* , is an apt mutation of the whole *Subject* , into the place of the whole *Predicate* , and of the whole *Predicate*, into the place of the whole *Subject* , keeping the same Quality, but sometimes changing the Quantity ; as, *Every Man is a Living Creature* ; *some Living Creature is a Man.*

36. This *Conversion* is three fold ;

1. *Simple,* in which the Predicate is changed into the place of the whole Subject , and the Contrary , keeping the same both Quality and Quantity ; as, *No Man is a Stone , therefore no Stone is a Man.*

2. By *Accident,* in which the whole Predicate is changed into the place of the whole Subject , and the Contrary , keeping the same Quality , but changing of the Quantity ; as , *Every Man*

N 3   *is*

is a Living Creature, therefore some Living Creature is a Man.

3. By *Contraposition*, in which the whole Subject is changed into the place of the whole Predicate; and the contrary, keeping both the same Quality and Quantity, but changing the terms from Finite to Infinite; as, *Every Man is a Living Creature, therefore every thing that is a Living Creature, is not a Man:* What Propositions may be converted this or that way, these Verses do express.

> *E E, I I, Conversion Simple make.*
> *A I, E O, of Accident partake.*
> *A A, O O, for Contraposits sake.*

And what these Letters *A, E, I, O,* do signifie these Distichs do declare:

> *A, affirmes, E, denies both universal are,*
> *I, affirms, O, denies, but both particular.*

CHAP.

CHAP. III.

Of Definition and Division.

HAving done with the first part of *Logick*, namely, that which treateth of Themes. I come now unto the second, called the *Organical*, or that which treateth of *Logical* Instruments, and their Composition.

2. *Logical* Instruments are four; *Definition*, *Division*, *Argumentation*, and *Method*.

3. *Definition*, is the explication of the thing which is defined; and this is either *Nominal*, or *Real*.

4. A *Nominal Definition*, is that which sheweth the Signification of the Name; whether it be by giving the Etymology thereof, or by expressing it by some other Synonymous word more generally known.

5. A *Real Definition*, is that which sheweth what the thing is; and this is either *Perfect* or *Imperfect*.

6. A *Real* and a *Perfect Definition*, is that which doth explain the thing by Essential Attributes.

7. A *Real*, but *Imperfect Definition*, otherwise called a *Description*, is that which explains the Nature of a thing, by certain Accidental Attributes.

8. *Division*, is the Deduction of some thing that is large, into a straighter and narrower

com-

comprehension; and this is either of some ambiguous word, into its several significations, and then it is called *Distinction*, or of the whole into its parts.

9. The whole is either *Simple*, or *Aggregate*; *Division* of the whole, simply and properly so called, is threefold.

1. *Universal* into its subjective parts, or of the General into the Specials; as, to divide Animal into Man and Beast.

2. *Essential*, which resolves the whole into essential parts, and this either of a *Species* into its *Genus* and *Difference*, or of some special nature into its matter and form; as, *A Man into Soul and Body.*

3. *Integral*, which resolveth the whole into Integral Parts, and this is the Division of some individual, either into its sensible or material parts.

4. *Division* of the aggregated whole into its Parts, and by Accident is five fold.

1. When the Subject may be Divided by its Accidents; as, *Men are Learned or Unlearned.*

2. When an Accident may be Divided by its Subjects; as, *Feavers are in the Spirits or in the Humours, or in the Solid parts.*

3. When an Accident may be Divided by Accidents; as, *Good is either profitable, honest, or pleasant.*

4. When things may be Divided by their Objects; as, *Sight by Colours, Hearing by Sound.*

5. When

5. When Causes may be Divided by their Effects; and the Contrary; as, *Heavenly heat is from the Sun, and Elementary from Fire.*

CHAP. IV.

Of Argumentation.

ARgumentation is an Oration by which some Problem is proved by inference.

1. A *Problem*, is the Proposition or Question to be proved; the which Problem, when it is so proved is the Conclusion, and follows the Illative note, or note of Inference: All that which precedes is the Antecedent, that which follows is the Consequent or Conclusion; the Illative is commonly this word (*therefore*,) and in this doth the tye or force of the Argument consist.

2. *Argumentation*, may be considered either in reference to the form and manner of Arguing, which is the more general consideration; or as it is restrained to certain matter, as shall be shewed in his place.

3. The kinds of *Argumentation* are usually reckoned to be four; *Syllogism, Induction, Enthymeme, and Example*, but may be reduced to two; for an *Enthymeme* is nothing but an imperfect *Syllogism*; an *Example*, an imperfect *Induction*: Other less principal kinds of Argumentation there are, which either are of no use, or may be reduced to a *Syllogism*; as, *Sorites* and *Dilemma*, which are indeed redundant *Syllogisms*; *Sorites* Categorical, and *Dilemma* Hypothetical.

4. A

4. A *Syllogism*, is an Oration, in which something being taken for granted, something else not granted before, is proved or inferred from them.

5. A *Syllogism* is two fold, *Categorical*, in which all the Propositions are *Categorical* : or *Hypothetical*, in which one or more of the Propositions are *Hypothetical* ; in both which we are to consider the Matter and the Form.

6. The *Matter* of a Syllogism, is either *Remote* or *Next*.

7. The *Remote matter*, is that of which it is remotely made, as the Simple Terms which in the Propositions of the Syllogism are made Subject and Predicate.

8. The *Simple Terms* of a Syllogism are three, of which one is called the Middle Term, the other two are the *Major* and the *Minor* Extreams, The *Major* and *Minor Extreams* are the *Predicate*, and the other the *Subject* of the Question, and the Middle Term or Argument, is the Term not expressed in the Question, but is united once to the *Major Extream*, and once to the *Minor*.

9. The next or immediate matter of a Syllogism, is that of which the Syllogism is immediately made, as the three Propositions, which are made of the Simple Terms, of which the the first is called the *Major*, the second the *Minor*, and the third is called the *Conclusion*.

10. The form of a Syllogism is the right disposing of the twofold Matter, Next and Remote, and this comprehendeth two things, *Figure*, and

and *Mood* ; the one, to wit *Figure*, hath respect to the Remote Matter or Simple Termes, and Mood respects the next Matter or the Propositions.

11. A *Figure*, is the fit disposing of the Middle Terms with the Extreams, in reference to Subjection and Predication ; this is threefold.

12. The first Figure maketh that which is the *Middle Simple Term* to be the *Subject* in the *Major* Proposition and the *Predicate* in the *Minor*.

13. The second Figure, maketh the *Middle Simple Term* to be the *Predicate*, both in the *Major* and the *Minor* Propositions.

14. The third Figure maketh the *Middle Simple Term* to be the Subject both in the *Major* and the *Minor* Propositions ; according to these Distichs.

Both sub and præ, doth the first Figure use.
Twice præ the next, the third twice sub I muse.

15. A *Mood* is the disposing of the Propositions according to Quantity and Quality.

16. There are 19 Moods, of which there are nine in the first Figure ; four in the second ; and six in the third, according to these Verses.

1. *Barbara, Celarent, Darii, Ferio, Baralipton.*
Celantes, Dabitis, Fapesmo, Fricesomorum.
2. *Cesare, Camestres, Festino, Baroco.*
3. *Darapti :*
Felapton, Disamis, Datisi, Bocardo, Ferison.

17. These

17. Thefe Moods are fo many Words of Art, which ferve only to denote the Quality and Quantity of every Propofition, by help of the Vowels, *A, E, I, O*, as hath been fhewed already; and are fome of them Perfect, as the four firft Moods in the firft Figure, and all the Moods in the fecond and third Figures; the reft are Imperfect.

18. And the Queftion Propounded is proved by or inferred from the premifes, by help of thefe Moods two ways, *viz. Directly* and *Indirectly*.

1. *Directly*, when the *Minor* Extream is the *Subject* in the *Conclufion*, and the *Major* in the *Predicate*.

2. *Indirectly*, when the *Major* Extream is the *Subject* in the *Conclufion*, and the *Minor* the *Predicate*, and this is in the five laft Moods of the firft Figure only; according to thefe Diftichs.

All the Nineteen directly do conclude,
Except of Figure firft, the laft 5 Mood.

19. Thefe things premifed, a Syllogifm, may be made in any Mood and Figure in this manner.

The Queftion propounded is always the conclufion of the Syllogifm, and by the Quantity thereof doth plainly fhew in what Mood or Moods it may be framed, and by confequence, in what Figure alfo.

20. If the Syllogifm be to be made in fuch a Mood as doth directly infer the *Conclufion* from the *Premifes*; then the *Subject* in the *Propofition* is the *Minor* Extream, and the *Predicate* the *Major*, as in the four firft Moods of the firft Figure, and in all the Moods of the fecond and
<div align="right">third</div>

third Figures ; but in the five last Moods of the first Figure, the *Subject* in the *Proposition* is the *Major* Extream, and the *Predicate* the *Minor* ; and the Middle Term is the Cause or Argument by which the truth or falsitie of the *Proposition* is to be proved.

21. The Middle Term or Argument being joyned to the *Major Extream*, doth make the *Major Proposition*, and being joyned to the *Minor Extream*, it maketh the *Minor Proposition*.

Example.

Let this be the Proposition , *No Man is a Stone :* This Proposition being an Universal Negative, the Syllogism may be framed in *Celarent, Celantes, Cesare* or *Camestres* ; if in *Celarent, Man* is the *Minor Extream*, and *Stone* the *Major* ; and to find out the Middle Term, I consider of some Reason or Argument by which to prove the Question ; as, *A Man is not a Stone, because he is a living Creature* ; so then *Living Creature* is the Middle Term, and these three Terms being thus placed ;

Middle Term.

Living Creature.

Minor Extream.   **Major Extream.**

Man.   *Stone.*

Because

Because *Celarent* belongs to the firſt Figure, the Middle Term *Living Creature* muſt be the *Subject* in the *Major Propoſition*, and the *Predicate* in the *Minor*; thus,

	Subj.	Præd.
Major.	Living Creature.	———— ————
Minor.	———— ————	Living Creature.
Conclu.	No Man is a Stone.	

And joyning this Middle Term to the *Major. Extream*, and alſo to the *Minor*; the ſeveral Propoſitions will be theſe;

Major.   *A Living Creature is not a Stone.*
Minor.   *A Man is a Living Creature.*
Conclu.   *A Man is not a Stone.*

Laſtly adding the Quantity to every Propoſition according to the Vowels in this Mood, the Compleat Syllogiſm is,

Major.   *Ce-*   *No Living Creature is a Stone.*
Minor.   *la-*   *Every Man is a Living Creature.*
Conclu. *rent.* *No Man is a Stone.*

The like may be done in the other Moods.

22. An *Enthymem*, is an Imperfect Syllogiſm, inferring the Concluſion from ſome one Propoſition only; as, *A Man is a Living Creature, therefore he hath a Soul.*

23. An *Induction*, is an Imperfect Syllogiſm, in which from many Singulars, ſome Univerſal Conclu-

Conclusion is inferred ; as, *This Man is a living Creature, and that Man is a living Creature,* &c. *therefore every Man is a living Creature.*

24. *Example* , is an Imperfect Syllogism, in which from one or more Singulars, we infer another particular ; as, *Catiline was punished for making of Sedition , therefore this Seditious Fellow should be punished.*

25. *Sorites* , is an Imperfect Syllogism , in which, from four or more Premises, we infer a Conclusion, in which the first Subject is joyned with the last Predicate ; as, *Socrates is a Man, a Man is a living Creature, a living Creature is a Body, a Body is a Substance* , therefore *Socrates is a Substance.*

26. A *Dilemma,* is an Argumentation which by disjoyning of the Members, doth so enforce the Adversary , that which part soever he chooseth, he will be catched ; as, *Tribute must be given to* Cæsar, *or to God* ; *If to God, then not to* Cæsar, *and this is Treason* ; *If to* Cæsar, *then not to God , and this is Sacriledge.*

And thus much concerning a Syllogism in the General, with the several kinds and forms thereof.

CHAP

CHAP. V.

Of A Material Syllogism.

I Come now to speak of a *Special* or *Material Syllogism*, as it is constrained to certain Conditions of Matter.

2. A *Special* or *Material Syllogism*, is of three sorts; *Apodictical, Dialectical* and *Sophistical.*

3. An *Apodictical Syllogism*, otherwise called a *Demonstration*, may be defined two wayes; either from the end, or from the matter of *Demonstration.*

4. From the end of *Demonstration*, an *Apodictical Syllogism*, is a *Syllogism* begetting knowledge, or making to know. And we are then said to know a thing, when we know the cause for which it is so, and cannot be otherwise.

5. All Knowledge is of such Conclusions, to which we assent, for our preceding knowledge of the Premises; and the *Pracognita* in every Science are these three: The *Subject*, the *Affection*, and the *Cause*. And the means by which these are foreknown, are called *Pracognitions*, and they are two; *That a thing is*, and *what a thing is.*

6. The *Subject*, is the less Extream in a *Demonstration*, concerning which some accident is Demonstrated by its next *Cause*; as, *a Man, concerning whom we must know both that he is*, and *what he is.*

O   7. *Af*

7. *Affection* or *Passion*, is a proper accident, which is Demonstrated of the *Subject*, by a proper *Cause*, it is always the greater Extream, which is Predicated in the Conclusion; as, *Risibility*, the which is necessary to be foreknown, in respect of its name, *What it is*, but not, *that it is*; for that is the thing to be enquired after, the thing we are to find by Denomination.

8. A *Cause*, is that by which the *Affection* is Demonstrated of its *Subject*, and is always the *Major Proposition* in the Demonstration; as, *Every rational Animal is risible*; what the *Cause* is cannot be foreknown, because it is a compounded Proposition, but it ought to be known, That it is, or else the Conclusion cannot be inferr'd from it.

9. An *Apodictical Syllogism*, being defined from the matter of Demonstration, is a *Syllogism*, which proveth its Conclusion from such Premises, as are of themselves sufficiently known.

10. A *Demonstration*, is to be considered, either in respect of the Matter or in respect of the Form.

11. In respect of the Matter, one kind of *Demonstration*, sheweth why the *Predicate* is inherent in the *Subject*, and another sheweth that it is inherent in the *Subject*.

12. In the first of these kinds of Demonstration, called the *Demonstration causal*, why a thing is; the Conditions to be observed, do partly belong to the Question, partly to the *Cause* or *Medium* of the *Demonstration*, and partly to the *Premises*.

13. Every

13. Every Question doth not admit of the first and most perfect kind of Demonstration, called, *Why a thing is* ? but such a Question only as is true, and hath a certain and immutable Cause of its own Truth.

14. The *Medium* of a Demonstration, ought to be the next Cause of the *Predicate* ; and that either *Efficient* or *Final*, and the *Efficient* either *Internal* or *External.*

15. The conditions to be observed in the Premises of a Demonstration, are *Absolute* or *Relative.*

16. The *Absolute Conditions* are two ; the first is, that the Propositions be necessarily true and reciprocal ; The second, is that they be immediate or first, in respect of the Subject ; as, *A Man is Rational*, and in respect of the Causes ; as, *That which is rational, is visible, a Man is rational*, Ergo.

17. The *Relative Conditions* to be observed in reference to the Conclusion, are three : 1. That the *Premises* be the Cause of the *Conclusion.* 2. That they be before it : and 3. That they be more known than the *Conclusion.*

18. The other less principal kind of Demonstration in respect of the Matter, or the Demonstration *what*, is twofold, the one is from some sensible Effect, and the other from a remote Cause.

19. The form of these Demonstrations, is discerned partly from the *Quantity*, and so it is *Universal* or *Particular* ; Partly from the

Quality,

Quality, and so it is *Affirmative* or *Negative*; Partly from the manner of the Proof, and so it is *Ostensive*, or by *Reduction* to Impossibility.

CHAP. VI.

Of a Topical Syllogism.

Hitherto we have spoken of a Demonstrative Syllogism, whose Matter is necessary, and the end a perfect Knowledge; come we now to a *Dialectical* or *Topical Syllogism*, whose Matter is Probable and Contingent, and the end Opinion.

2. In a *Dialectical*, or *Topical Syllogism*, we are to consider of *Problems*, *Propositions*, and *Invention of Arguments*.

3. A *Problem* or *Question*, is the thing of which it is probably discoursed, and the Conclusion of a Syllogism already made.

4. *Dialectical Propositions*, ought to be certain, at least probable, and not Paradoxes; now that is said to be Probable, which not being absolutely true, doth seem to be true rather than false: And that is said to be a Paradox, which is true, though contrary to the vulgar Opinion.

5. For the Invention of Arguments, we are to consider Common places and Rules.

6. A

6. A *Place*, is common Note, by whose help an Argument is found.

7. A *Rule* or *Canon*, is a Proposition, containing the Reason of the Consequence, in a *Dialectical Syllogism*.

8. *Arguments* are of two sorts, *Artificial* and *Inartificial*.

9. *Artificial Arguments*, are such as from the consideration of the parts of a Problem, are not found but by Rules of Art.

10. *Inartificial Arguments*, are such as are found without any help of Art, and these are nothing but Testimonies.

11. *Artificial Arguments*, may be raised from these Seven *Topicks* or *Heads*. 1. From the *Cause* and the *Effect*. 2. From the *Subject* and the *Accident*. 3. From *Dissentany* and *Comparison*. 4. From *Conjugates* and *Notation*. 5. From the Whole and its Parts. 6. From *Genus* and *Species*. 7. From *Definition* and *Division*.

12. A *Cause* in General, may be defined to be that, by whose power a thing is.

An *Argument* therefore from the *Cause*, is when in a probable Syllogism, the middle Term is the Cause of the *Major* Extream.

13. There are two kinds of *Causes*; *Internal* as the *Material*, or Matter, of which a thing is made; and the *Formal*, by which a thing is; as, *The shape and form of a Statue*.

External, as the *Efficient*, which doth bring the thing to pass; and the *Final* or *End*, for which a thing is done.

14. An *Argument* from the Efficient Cause, is when

when in a probable Syllogism, the *middle Term* is the Efficient of the *Major* Extream: as, *The Earth is Diametricaly interposed between the Sun and the Moon, therefore the Moon shall be Eclipsed.*

15. An *Argument* from the *Final Cause*, is when in a Probable Syllogism, the *Middle Term* is the *Final Cause* of the *Major* Extream.

16. An *Argument* from the *Material Cause*, is when in a Probable Syllogism, the *middle Term* is the *Material Cause* of the *Major* Extream, or the *Genus* or *Species* thereof.

17. An *Argument* from the *Formal Cause*, is when in a Probable Syllogism, the *middle Term* is the *Form, Definition, Description*, or *Difference* of the *Major* Extream.

18. In the *Topicks* of the *Subject* and the *Accident*, we do not take the *Subject* for the *Substance*, in which the *Accident* is inherent, or the *Accident* for that which doth precisely and adiquately adhere to the *Substance*; but *Subject* is here taken for all that, to which any thing not belonging to its essence is attributed : And *Accident* is here taken for any such attribute, as Number is the *Subject* of Equality, that is, it is an *Accident* of an *Accident*.

19. An *Argument* from the *Subject*, is as oft as the *middle Term* in a Probable Syllogism, is the *Subject* of the *Major* Extream.

20. An *Argument* from the *Accident*, is when in a Probable Syllogism, the *middle Term* is the *Adjunct* or *Accident* of the *Major* Extream.

21. The third *General Topick* for the Invention

tion of Arguments, is from *Dissentanies* and *Comparison*.

22. *Dissentanies*, are either *Opposites* or *Disparates*; as, *a Horse*, and *a Bull*: There are four kinds of *Opposites*; *Relative, Contrary, Privative*, and *Contradictory*. *Comparisons* are either in respect of Quality; as, *like and unlike*, or in respect of Quantity, or also of Degrees; as, *equal and unequal*; and what ever may be said to be *more* or *less* or *equal*.

23. An *Argument* from *Dissentanies*, is when in a Probable Syllogism, the *Middle Term* is opposed to the *Major* Extream, whether it be by way of a *Disparate*, or a *Contrary*, or otherwise.

24. An *Argument* from *Comparison*, is as oft as in a Probable Syllogism, one part of the *Major* Proposition is compared with the other, in reference to their agreement or their disagreement.

25. The fourth general *Topick*, for the Invention of Arguments, is from *Conjugates* and *Notation*. And they are properly called *Conjugates*, which for the affinity of Signification, have also an affinity in the Voice or Sound; as, *Just, Justice*, and *Justly*; some *Conjugates* are only Nominal, some Real, and some both, and do comprehend *Denominatives* under them, and are either *Substantives* where one is a *Noun Substantive* abstracted from the *Subject*; as, *Justice, Just*; or *Adjectives*, where they be both *Denominatives*, or *Concretes*, which shew the form in the Abstract; as, *Just, Justly*. *Notation* or *Etymology*, is the Explication of a Word by the Original thereof; as, *a Consul*, from *Counselling the Common-Wealth*.

O 4   26. An

26. An Argument from *Conjugates*, is as oft as in a Probable Syllogifm; the one the *Conjugates* in the *Major* Propofition, is the *Subject* of the *Major* Term; as, *He that doth Juftly is Juft.*

27. The firft General *Topick* for the Inventing of Arguments, is from the whole and its parts. And an Argument from the thing divided to the divided Members, is as oft as the thing divided is the *Middle Term*, and the dividing Members the *Major* Extream, in a Probable Syllogifm. And an Argument from the dividing Members, to the thing divided, is as oft as the dividing Members are the *middle Term*, and the thing divided the *Major* Extream.

28. The fixth General *Topick*, is from *Genus* and *Species*; And an Argument from *Genus* and *Species*, is when we prove that a thing doth not agree with the *Genus*, becaufe it doth not agree with the *Species*; or that it doth not agree with the *Species*, becaufe it doth not agree with the *Genus*.

29. The feventh General *Topick* for the Inventing of Arguments, is from *Definition*, and *Divifion*. We raife an Argument from the *Topick* or *Definition*, when we feek for the *Definition* of either Extream, that is, of the *Subject* or the *Predicate* in the Queftion, which being found, is put into the place of the *Mean*, that it may be known whether the Extreams fhould be conjoyned or feparated; thus we prove that *Peter* is a *Man*, becaufe he is a *Rational living Creature.* We argue from the *Topick* of *Divifion*, when we fhew fomething

to

to agree with the dividing Members, becaufe it agrees with the thing divided, or not to agree with the thing divided, becaufe it doth not agree with any of the Dividing Members.

30. *Inartificial Arguments*, are only fuch as are raifed from Divine or Humane Teftimony. And an Argument is raifed from Teftimony, as oft as the Authority of him that beareth witnefs, is the *middle Term*, agreeing or not agreeing with the *Major* Extream.

CHAP.

CHAP. VII.

Of a Sophiſtical Syllogiſm.

A Sophiſtical Syllogiſm, is a Captious Argu-
mentation, which is feemingly, or appa-
rently true, but is indeed deceitful.

2. *Sophiſtical*, or Fallacious Arguing, is either
in refpect of the Words or of the Things.

3. *Fallacies in Words*, are five; *Ambiguitie*,
Amphibolie, *Compoſition*, *Diviſion*, and *Figure
of a Word*.

4. *Fallacies in things* are feven, *Accident*,
Of a thing ſpoken after a ſort, to a thing ſpoken
Simply; Ignorance of the Argument; a falſe
or wrong Cauſe, Conſequent, Beginning of the
Queſtion, and an asking of many Queſtions.

CHAP.

CHAP. VIII.

Of Method.

MEthod is the dispofing of things belonging to the fame Matter or Subject, so, as that they may be beft underftood, and eafieft remembred.

Method is twofold, Natural or Arbitrary.

3. A Natural Method, is that in which the order of Nature and our diftinct Knowledge is obferved.

4. In a Natural Method, we muft fpeak firft of Generals, and then of Particulars; and as we proceed from one thing to another, every part muft have a dependence on that, which was laft fpoken of by fome apt tranfition.

5. A Natural Method, is either Total, or Partial.

6. A Total Method, is that in which a whole Science is Methodically ordered or difperfed. And this is either, Synthetical, or Analytical.

7. A Synthetical or Compofitive Method, is that which begins with the firft and moft Simple Principles, and so proceeds to thofe which do arife from, or are Compofed of the firft Principles.

8. An Analytical or Refolutive Method, is that which begins with the end, and so proceeds ftill lower and lower, till we come to the firft and moft Simple beginnings.

9. A

9. A *Partial Method*, is that, by which any part of any Art or Science is Methodically ordered or difpofed: or by which any particular Theme or Subject, is handled by it felf.

10. An *Arbitrary Method*, is that, which not regarding the Natural order, is fitted for fuch a confufed Knowledge, as may be moft taking with the People, or fute beft with their Capacities.

And thus much concerning *Method*, which is the fourth and laft *Logical* Inftrument; and with this I fhall conclude thefe my *Logical Precepts*, and laft Part of my *Englifh Academy:* He that defires to be more fully acquainted with thefe Arts and Sciences, may for all but *Mufick*, Read my other particular Tracts of thefe Subjects, till fome body that hath more knowledge in them, fhall furnifh us with more ample and perfect Imftructions; and as for *Mufick*, I am much of Opinion, that Mr. *Playford's Introduction* my very well ferve, to Inftruct our Youth in the firft Principles of that excellent Science; For which, and all other helps of Learning, *To the only Wife God, be all Honour and Glory, now and for ever.* Amen.

FINIS.

ERRATA.

Pag. 9. *line* 13. manner *read* manner. p. 29. l. 5. lines r. times. p. 30. l. 22. or four r. of four. p. 36. l. 22. laſt r. leaſt. p. 37. l. 1. laſt r. leaſt. p. 41. l. 14. 5. r. 5 p. 50. l. 19. demonſtration r. demand p. 54. l. 16. line r. time. p. 61. l. 23. at r. to. p. 62. l. 8. Tables, that r. Tables is ſuch, that. p. 71. l. 27. r. and the Side Sub-tending. p. 84. l. 19. r. contained by planes. p. 90. l. 9. r. have the ſame ſound or tune. p. 92. l. 4. when r. where. p. 99. l. 16. is the ſhorteſt r. and the ſhorteſt. p. 114. l. 16. r. o s of the c s = S. p. 125. l. 6, 7. is the Suns greateſt r. from the Suns leaſt Meridian Altitude is.

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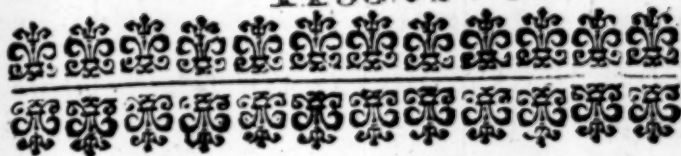
TO THE

READER.

I Have perhaps troubled thee and the Press already too much; if it be so, I shall however hope, that I am not unpardonable, because I have still intended well to the good of the Publick; every one I think desires to give their Children the best Education that they can; but the highest degree of Education is not always best: And I must beg thy Pardon, if I do offend

thee,

thee, in faying, That next to the bare Reading of *English*, the fending of Children to the *Latin-School*, is not the beft way of giving them Education, for if that were granted, which I muft deny, That the *Latin* and *Greek* Tongues were not only neceffary for all Children whatfoever, but alfo more eafily learned, than the liberal Arts; yet *Writing* is fo neceffary to be firft Learned, that it is almoft impoffible to attain the other without it.

And as *Writing* is very neceffary in order to the *Latin* and *Greek* Tongues, fo is it alfo neceffary in order to the true Spelling and Underftanding of the *English*, or any other Native Language; and indeed the Art of *Grammar* is the only One of the Seven, that claimes a propriety in every Native

tive Language : As for the other
Arts, they are the fame, in all
Languages, the Rules of *Arithme-*
tick and *Geometry*, of *Mufick* and
Aftronomy, of *Rhetorick* and *Lo-*
gick, are in the General, as Intel-
ligible in every Language, as in
the *Latin* and *Greek*, or any other ;
and therefore to them, that have
no other need of the *Latin* and
Greek Tongues, than the Lear-
ning of thefe Arts, may, I con-
ceive, fpare that pains, and Learn
them in their own Native Lan-
guage, or as many of them, as
will be thought ufeful for them,
in their feveral Stations in the
World.

Again, thefe Arts are not only
attainable in every Native Lan-
guage, but more eafily attaina-
ble than the *Latin* and *Greek*
Tongues are, to which fome feem

defirous

desirous to confine the Arts; and
being so attained, do render other
Languages more easie also.

For these, and the like Reasons,
as I have already Published distinct
Introductions to every Art, except
Musick ; for which I refer thee to
Mr. *Joh.* *Playford's* Introduction; so
now I have been easily perswaded
to give thee a short view of them
altogether; he that desires more
full Instruction, may peruse the
several Tracts by me Written, in
our own, or those that are written
by other Men in other Languages.
The whole Building is but small,
and therefore I will not make the
Porch great, I have placed the
Arts in that Order, in which, (with
submission to better Judgements)
I do conceive they should be lear-
ned : And although I cannot say
now, as I have in some of my
<div align="right">Epistles</div>

Epiftles preceding my former Tracts , that there is not fo much as one *Mathematical School* in *England*, for now there is by His Majefties Bounty a fair Foundation laid in *Chrift-Church-Hofpital, London*, and one chofen to Manage it, by Name Mr. *J. Leake*, who is fo well known, that he needeth no Mans Commendations to exprefs his Worth ; Yet thus much I ftill declare to be my Opinion , That it is more proper, that the *Latin* School fhould be fupplied with Scholars from the *Mathematical* , than that the *Mathematical* fhould be fupplied from the *Latin* and *Greek* Schools s However by this means , I hope it will come to pafs, that afterages will be fupplied with that Knowledge in *Arithmetick*, *Geometry* , and *Aftronomy*, which hitherto our *Writing*-Mafters have

not

not been able to Teach, nor our *Grammar* Masters either able or willing to undertake; so that in a Word, There are few Country School-Masters that can Teach these things : But yet amongst them, the well Accomplished Mr. *Perkins* of *Guildford*, with whom I have not had the happiness to be immediately Acquainted, yet Report hath rendred him to the World a worthy Master and Teacher of that Science. And there are not many Tutors in either of our Universities that do; and yet the usefulness of these Arts cannot be denied, and therefore my hopes are, that some Universal Encouragement will yet be given for the Teaching of them.

And could I be so happy, as to see something done in order to it,

I

I fhould think my felf abundant-
ly fatisfied for all the Pains I have
hitherto taken, and fhall ever
reft,

Thine and his Countrys Servant,

JOHN NEWTON.

THE
PREFACE
OR
INTRODUCTION
TO THE

Arts and *Sciences* in the General.

Ísdom is the *Principal thing*, and therefore faith Solomon, Get Wiſdom, and with all thy getting, get Underſtanding. Prov. 4. 7. *and what is meant by Wiſdom*, *Holy* Job *tells us*, Job 28. 28. Behold the Fear of the Lord, that is Wiſdom, and to depart from Evil, that is Underſtanding. *They who ſeek*

for

for this *Wisdom*, are the only true Philo-
sophers; *for* Philosophie *is nothing else
but the love of Wisdom, and they who*
Fear God, and depart from Evil, are the
lovers of that, which is the only real and
true Wisdom: Now *for as much, as we*
cannot be said to fear God, except we know
him, Wisdom may well be defined to be,
the Knowledge of God and the things that
are of him, the knowledge of things Di-
vine and Humane, and this is commonly
called Philosophie*, but somewhat impro-*
perly, for Philosophie *is not properly the*
Knowledge it self, but the love of that
Knowledge; and whatsoever Art or Sci-
ence *doth conduce to this Knowledge, may*
be rightly and truly called Sophia*, or* Wis-
dom; *and because all Men should love*
such Knowledge and Delight in it, I shall
not gainsay the general Name by which it
is called, custom will have it so, let it
therefore be called Philosophy.

Sophia *then, or* Philosophia*,* Wisdom,
or the love of Wisdom*, is the Knowledge*
of all Arts and Sciences, which any way
do conduce to the Knowledge of God: And
because some of them do thereunto conduce
more, some less: These arts may be distin-
guished

guished into two Sorts , Superiour and Inferiour.

The Superiour Arts are four ;

1. Theologie or Divinity, whose Subject is the Divine Essence.

2. Metaphysicks , otherwise called the first Philosophy, whose Subject is , Being in common , or Being as Being.

3. Physicks , whose Subject is the Knowledge of Natural Bodies , as they are Natural.

4. Ethicks , whose Subject is Morality , or the Doctrin of Manners and civil Honesty.

The Inferiour Arts are of two sorts ;

1. Internal or Liberal Arts , so called , because they are attained by the Faculties of the Soul , which is a liberal or free agent , and not by the Labour or Ministry of the Hands ; and these are seven :

1. Grammar,		5. Astronomie,
2. Arithmetick,		6. Rhetorick,
3. Geometrie ,		7. Logick.
4. Musick ,		

And these are the Subjects of this little Book.

2. *The* External *or* Mechanical *and* Manual Arts, *so called, because they depend more upon the labour of the Body, than the Mind; such are the Arts of* Tillage, Hunting, Fishing, Fowling, Weaving, *and many more, not needful to be named, because no part of the ensuing Discourse.*

THE

THE *ENGLISH*
ACADEMY.
The FIRST PART.

OF GRAMMAR.
BOOK I.

CHAP. I.

Of Letters and Syllables.

Grammar is an Art which Teacheth how to Speak and Write truly.

The Parts thereof are Four, Letters, Syllables, Words and Sentences.

A Letter is a Character, or Index, of a simple sound. And in the *English* Tongue there are Twenty four.

The which Letters are distinguished from one another, partly by their shapes, and partly by their sounds.

B In

In reference to their shapes, they are distinguished by three different Characters, the *Roman*, *Italick*, and black *English*.

And in each of these Characters there is the great and the small Letter.

In the *Roman* Character, the great Letter is thus formed,

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

———The small thus,

a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, ſ, s, t, u, v, w, x, y, z.

The great and small *Italick* Letters are made thus.

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, ſ, s, t, u, v, w, x, y, z.

The great and small black *English* thus,

A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q, R, S, T, U, W, X, Y, Z.

a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, z, ſ, s, t, u, v, w, x, y, z.

The great Letters are used in the beginning of proper Names, Emphatical words, Sentences, and Verses. The Letter *I* when it stands alone, is always written with a great Character.

These

These Twenty and four Letters are divided into Vowels and Consonants.

A Vowel is a letter which maketh a full and perfect sound of it self, and they are five; *a, e, i, o, u,* besides the *Greek* Vowel *y.*

A Consonant is a letter which maketh a sound by help of a Vowel, and these are Eighteen, besides the letters *j, v,* and *y,* which sometimes are Consonants also.

Of the eighteen Consonants, some are mutes, as these eight, *b, c, d, g, k, p, q,* and *t.* Some semi-Vowels, as these eight, *f, l, m, n, r, s, x,* and *z,* of which these four, *l, m, n, r,* are also called Liquids, *x* and *z,* double Consonants, and the other two, *h* and *w,* irregular Letters.

Some of these Letters, as well Vowels as Consonants, have sounds very different from their common names. Thus the letter *c* before *e,* and *i,* is sounded like *s,* but before *a, o, u,* it is sounded like *k,* as in *car, cor, cut.*

The Letter *f,* is sometimes sounded according to its usual name, as when it follows a Vowel, as in *if, of, effeminate,* but when it begins a Word or Syllable, it is sounded *fee,* as in *feet, foolish.*

The Letter *g,* before *a, o,* and *u,* is sounded hard thus, *ghee,* as in *gad, God, gun,* but before *e* and *i* it is sometimes, but not always, sounded according to its usual name *gee,* as in *danger, ginger.*

The Letter *h* is never sounded according to its name *ach,* but thus, *hee,* as in *hand, help, him.*

The

The Letters *j* and *v*, when they come before themselves or any other Vowel in the same Syllable, become Consonants and have different sounds from their usual names, *j* is pronounced like *g*, soft, thus *ji* is pronounced like *gi*, in *ginger*, *u* is pronounced *vee*, or *vu*, as in *vanish*, *vine*; and when they are thus sounded, their shape is also changed, and hence some would have them to be distinct Letters, and would have the number of our Letters to be not 24, but 26.

The Liquids *l*, *m*, *n*, and *r*, when they begin a Word or Syllable, are sounded thus, *lee*, *mee*, *nee*, *ree*, as in *light*, *mind*, *need*, *read*.

The Letter *q*, hath alwayes *u* after it, to help its sound, but is not to be sounded according to its name *eu*, but *que*, as in *question*.

The Letter *ſ*, when it begins a Word or Syllable, is to be sounded thus, *ſee*, as in *ſad*, *ſecret*, but in the end of a Word, or between two Vowels or Diphthongs, it hath for the most part the sound of *z*, as in *eaſie*, *boſom*.

The Letter *t*, before *i*, if another Vowel followeth hath the sound of *ſi*, as in *Egyptian*, *patience*; but when it followeth *ſ* or *x*, it hath its own proper sound, as in *beſtial*, *mixtion*.

The Letter *w*, hath its name from its shape, being composed of twice *u*, it is called double *u*, but is in no case so sounded, but *we*, as in *wall*, *well*, *will*.

The Letter *x*, when it begins a Word or Syllable, is sounded thus, *xee*, as in *Xerxes*; in other cases thus, *ex*, or *ecs*.

The

The Letter *y*, hath by no means its found according to its ufual name *wi*, but when it begins a Word or Syllable, and fo becomes a Confonant, it is founded *yee*, when it comes in the middle or end of a Word, it is founded like *i* Vowel, as in *my, thy*.

The Letter *z*, is to be founded *zee*, as in *Zeal*.

A Syllable is a literal or articulate Voice of one individual found.

Syllables are of two forts, improper and proper.

An Improper Syllable is made of one or more Vowels without a Confonant., as *a-ny*, *e-vil*, *Æ-neas*, *Oe-dipus*.

A Proper Syllable is the comprehenfion of one or more Confonants, with one or more Vowels, in one found or breath; as *Ge-ne-ra-ti-on*, *Moun-tain*, and in our *Englifh* Tongue doth fometimes confift of eight Letters, as *ftrength*.

When two Vowels are joyned together in one found or breath, they are called Dipthongs; of which there are two forts, Proper and Improper.

Of proper Dipthongs, there are thefe eight, *ai*, *ei*, *oi*, *au*, *eu*, *ou*, *ee*, and *oo*.

The firft fix are fometimes written thus, *ay*, *ey*, *oy*, *aw*, *ew*, *ow*.

Of improper Dipthongs there are but thefe three, *ea*, *oa*, and *ie*.

The two Vowels which make a Dipthong, are for the moft part to be founded together,

as in *Faith*, *neither*, *Eunuch*, but in these words, *Laity*, *Mosaick-work*, *Deity*, *Atheist*, *moity*, *doing*, *reenter*, *reiterate*, and such like, and in most Proper Names in the Bible they are to be sounded severally.

The Improper Dipthongs *ea* and *oa*, are sounded together, except in these Words, *beatitude*, *creator*, *creation*, *real*, *theatre*, and most proper names of Women, Cities, and Countries; but the two Vowels in this Dipthong *ei*, are usually parted; except in these two Words, *friend*, *grief*, and when they come in the end of a Word, as in *mercie*, *charitie*, and such like.

An *English* Syllable, though it may consist of eight Letters, yet doth it never begin with more than two Vowels before a Consonant, or three Consonants before a Vowel or Dipthong.

The two Consonants which may begin an *English* Word or Syllable are these thirty, *Bl*, *br*, *ch*, *cl*, *cr*, *dr*, *dw*, *fl*, *fr*, *gl*, *gn*, *gr*, *kn*, *ph*, *pr*, *sc*, *sh*, *sk*, *sp*, *st*, *sm*, *sn*, *sq*, *sw*, *th*, *tr*, *tw*, *wh*, and *wr*.

And the three Consonants that may begin an *English* Word are these nine, *Sch*, *scr*, *shr*, *sky*, *spl*, *spr*, *str*, *thr*, *thw*.

In the sounding of the Consonants which are joyned together in the beginning of a Word, there is no difficulty, but in these few, *ch*, *gh*, and *th*.

The Letters *ch* when they come before a Vowel in a pure *English* Word, they are to be sounded as in *chance*, *cheap*; and when they

<div align="right">com</div>

come after a Vowel, they are to be founded, as in *ach*, *reach*, *rich*. But in Words derived from the *Greek* and *Hebrew*, they are to be founded like *k*, as in *character*, these few only excepted, *Rachel*, *Cherubin*, *Tychicus*, *Arch-Bishop*, *Arch-Duke*, *Architect*, *Arch-enemy*, *Arch-pirat*.

The Letters *gh*, in the beginning of a Word, are to be founded like *g* hard, as in *ghost*, *ghess*, in the middle of a Word, they are either not founded at all, or but softly, as in *might*, *light*, and in the end of a Word they have the found of *ff*, as *cough*, *tough*.

These Letters *th*, in Words of one Syllable and in Words of more than one, ending in *ther*, *thed*, *theth*, *thest*, *thing*, they have the found of *d*, in other words the found of *t*, or the Greek *Theta*.

The Letters *ph* never begin a pure *English* Word, but such only as are derived from the *Greek* and *Hebrew*, as *Pharisee*, *Pharez*, *Epitaph*, and in these they are founded like *f*.

The Liquids, *l*, *m*, *n*, *r*, when another Consonant doth precede them in the beginning or middle of a Word, do retain their own found, but in the end of a Word, though the Vowel ought to be written, yet in the pronunciation, you must stop at the two Consonants, and omit the Vowel; for Example, *fable*, *acre*, *uncle*, must be pronounced as though they were written thus, *fabl*, *acr*, *uncl*.

B 4 The **CHAP.**

CHAP. II.

Of Words.

A Word, is such a comprehension of Letters and Syllables, as helpeth Man-kind to exprefs their minds to one another.

There are eight kinds of Words, or parts of Speech, *Noun, Pronoun, Verb, Participle, Adverb, Conjunction, Prepofition, Interjection.*

A *Noun*, is the name of a Perfon or Thing; as, an *Author*, a *Book*, *learned*, *guilded*.

Of *Nouns*, fome be *Subftantives*, and fome be *Adjectives.*

A *Noun Subftantive*, is a Word, that fignifieth fomething, and may have the fign *(a)* or *(the)* before it; as, *a Man*, *the Book*.

A *Noun Adjective*, is a Word, that cannot fignifie a thing of it felf; as, *good, bad.*

There are two forts of *Nouns Subftantives.*

A *Noun Subftantive* proper, and a *Noun fubftantive* common.

A *Noun fubftantive* proper, is a *Noun* that is proper to the perfon or thing, that it betokeneth; as, *Henry, England.*

A *Noun fubftantive* common, is a *Noun* common to all things of the fame kind; as, *a Man, a Land, an Angel.*

To a *Noun* there doth belong two things, number and comparifon.

There be two *Numbers*, the *fingular* and the *plural*; The *Singular number* fpeaketh but of
One,

One; as, a *Man*, a *Book*, a *Stone*. The *Plural number* speaketh of more than One; as, *Men*, *Books*, *Stones*.

Nouns substantive of the *singular number*, are turned into the *plural*, by adding unto them *s* or *es*, as *web*, *webs*, *robe*, *robes*, *Church*, *Churches*, *hedg*, *hedges*. Some *Nouns* of the *singular number* ending in *f*, being *plurals*, do change *f* into *v*, as *beef*, *beeves*, *calf*, *calves*. And some are made *plurals*, by adding of *en* or *ren*; as, *Ox*, *oxen*, *chick*, *chicken*, *brother*, *brotheren*, or by contraction, *brethren*, *child*, *children*; of *Man* is formed *manner*, or *men*, *house*, *housen*, *hose*, *hosen*; to which may be added, *mouse*, *mice*, *louse*, *lice*, *die*, *dice*, *sow*, *swine*, *cow*, *kine*, *penie*, *pence*, *goose*, *geese*, *tooth*, *teeth*, *foot*, *feet*; these two, *Sheep* and *Mile*, are both *singular* and *plural*; as, *one sheep*, *ten sheep*, *one mile*, *ten mile* or *miles*.

Other variation of *Nouns* we have none in the *English* Tongue; all other distinctions are made by these Articles and Prepositions; *a*, *of*, *to*, *the*, *o*, and *in* or, *from*, *&c*.

Nouns that signifie the Male kind, we call *hees*; such as signifie the Female, we call *shees*; and of such as signifie neither, we say *it*; as, *Esau* could not obtain his Fathers Blessing, though *he* sought *it*, with tears: *Jezabel* was a wicked Woman, for *she* slew the Lords Prophets.

Comparison belongeth only to *Nouns Adjectives*, whose signification may be increased, or diminished.

There be three degrees of *Comparison*, the *Positive*, *Comparative*, and the *Superlative*.

The

The *Positive degree* setteth down the quality of a thing absolutely without excess, as *hard*, *soft*, *swift*.

The *Comparative degree* raiseth the signification of the *Positive* in comparison of some other, as *harder*, *softer*, *swifter*.

The *Superlative* exceedeth his *positive* in the highest degree, as *hardest*, *softest*, *swiftest*.

Adjectives are compared in the *English* tongue, either by the signs *more* and *most*, or by the terminations *er*, and *est*, as *hard*, *harder*, or *more hard*, *hardest*, or *most hard*.

Some *Adjectives* are compared irregularly; as, *Good, better, best*; *bad, worse, worst*; *little less, least*.

CHAP. III.

Of a Pronoun.

A *Pronoun* is a part of Speech, much like to a *Noun*, implying a Person, and not admitting the Sign *a* or *the*, before it.

There are twelves *Pronouns*, *I, Thou, He, who, which, that, the same, my, thy, this, his, whose.*

Of *Pronouns*, some be *primitives* and some *derivatives*.

Pronoun primatives are of three sorts, *Personal, Relative* and *Demonstrative*.

There are three *Pronoun personals*, *I, Thou,* and *He.*

Pronoun Relatives, are likewise three, *who*, *which* and *that*.

Pronoun Demonstratives, are these two, *this*, *the same*.

Pronoun Derivatives are these four, *my*, *thy*, *his*, *whose*. All which with their variations, are expressed in the following Type.

Possessives.

1. Person.	Sing.	I, me, my, mine.
	Plur.	we, us, our, ours.
2. Person.	Sing.	thou, thee, thy, thine,
	Plur.	ye, you, your, yours.
3. Person.	Sing. Mal.	he, him, his.
	Fem.	she, her, hers.
	neith.	it, its.
	Plur.	they them, their, theirs.
Relatives.	To pers.	who, whom, whose.
	To thing.	what, whereof.

Own is a *Noun adjective*, and *self* or *selves* a *Substantive*, but are sometimes joyned to, or compounded with the *Pronouns*; as, *my self*, *thy self*, *themselves*, *his own self*, *their own selves*.

This word *where*, with certain Prepositions following it; as, *about*, *at*, *by*, *in*, *of*, *unto*, *with*, hath the signification of *which as*, *wherein*, or *in which*. And these words, *here*, *there*, are in like manner used for, *this*, *that*; as, *herewith*, *therewith*, for *with this*, *with that*.

CHAP.

CHAP. IV.

Of a Verb and Participle.

A *Verb* is a part of Speech, that joyneth the Signification of other Words together.

There are three kinds of *Verbs*; *Active*, *Passive*, and *Neuter*.

A *Verb Active*, is a *Verb* that betokeneth doing, as *I love*.

A *Verb Passive*, is a *Verb* which betokeneth suffering, as *I am loved.*

A *Verb Neuter*, is a *Verb* which betokeneth being, as *I am.*

Four things belong to a *Verb*; *Mood*, *Tense*, *Number*, and *Person*.

There are four *Moods*, the *Indicative*, the *Imperative*, the *Potential*, and the *Infinitive*.

The *Indicative* either sheweth a reason true or false, as *I love*, or asketh a Question, as, *dost thou love?*

The *Imperative Mood*, intreateth, permitteth, or commandeth, as *love he*, or *let him love*.

The *Potential Mood*, signifieth a power, duty, or desire, and hath one of these Signs, *may*, *can*, *might*, *would*, *should*, *could*, or *ought*, as *I may or can love*.

The *Infinitive Mood*, notes no certain Number or Person, but followeth another *Verb*, or an *Adjective*, and hath commonly this Sign (*to*) before it, as *I desire to learn, worthy to be praised*.

The *Tenses* or distinctions of Time, are five,

The

The *Present Tense*, the *Preterimperfect Tense*, the *Preterperfect Tense*, the *Preterpluperfect Tense*, and the *Future Tense*.

These *Tenses* in respect of signification, are thus distinguished; in the *Indicative Mood*, *do* is the sign of the Present Tense, *did* of the Preterimperfect Tense, *have* of the Preterperfect, *had* of the Preterpluperfect, *shall* and *will* of the Future,

In the *Potential Mood*, by the signs already given, the Present Tense by the signs *may* or *can*, the Preterimperfect *would*, *should*, *could*, or *ought*, and the Preterperfect, by annexing the sign have to the former Signs, and the Future, by adding *hereafter* to the signs of *may* or *can*, the Signs of the Present; as, *I may or can hereafter*, the Preterpluperfect in this Mood is wanting in the *English* Tongue.

But in respect of Termination, there are no Moods but one, no Tenses but two, namely, the *Present*, and *Preterimperfect* Tenses.

And the Preterimperfect Tense is formed from the Present, by adding thereto the termination *(ed)* and in some few the termination *(en)* as of *love* is formed *loved*, of *fall*, *fallen*.

The Persons in every Tense are distinguished by the personal Pronouns, *I*, *Thou*, and *He*, in the Singular Number, and *We*, *Ye*, *They*, in the Plural; only the Second Person Singular in the Present and Preterimperfect Tenses is formed from the first, by adding thereto the Termination *est*, as of *love*, *lovest*, of *loved*, *lovedst*; and the Third Person Singular in the Present
Tense

Tense is formed from the First, by adding thereto the Termination (*eth*) as of *love* is formed *loveth*, other variations of Persons or Tenses there is none, but what is done by Signs, as was said before.

A *Verb Active* then is thus formed in the *Indicative Mood*.

<div align="center">Present Tense.</div>

Sing. Love, lovest, loveth.   *Plur.* Love, *Infinitive*, To love.

<div align="center">Preterimperfect Tense.</div>

Sing. Loved, lovedst, loved.   *Plural.* Loved.

This *Verb Neuter*, *Am* or *Be* is thus formed.

In the *Present* ⎰ Am, art, is, ⎱ *Plur*. Are.
Tense.   ⎱ Be, beest, be, ⎰ *Plur*. Bee.
In the *Preterim-* ⎰ Was, wast, was, ⎱ *Plural*.
perfect *Tense*. ⎱ Were, wert, were, ⎰ Were.
Infinitive.   To be.

A *Verb Passive*, is the same throughout all Moods and Tenses, with a *Verb Neuter*, the *Preterimperfect Tense* of the Active Voice, being added thereunto; Thus the Passive Voice of this Verb Active, *I love*, is formed, by adding *loved* to all the Tenses and Persons of this Verb Neuter, *I am*.

<div align="center">For Example.</div>

The *Present Tense* of the *Indicative Mood* is thus formed,

<div align="right">I</div>

I am loved ,	We
Thou art loved ,	Ye are loved ,
He is loved.	They

A *Particle* is a part of Speech , derived of a Verb , from which it hath Signification , of Time present , past , or to come.

There are two *Particles* , one of the Active, and another of the Passive Voice.

The *Particle* of the Active Voice is derived from its Verb , by adding the Termination (*ing*) to the *Present Tense* ; as of *love, loving.*

The *Particle* of the Passive Voice is for the most part, the same with the *Preterimperfect Tense* of the Active ; as the *Participle* of the Passive Voice in this Verb *love* is *loved.*

From this General Rule many Verbs are Excepted , for of

Make		made	take, took, taken
lead		led	shake, shook, shaken
bereave		bereft	seeth, sod, sodden
smell		smelt	shear, shore, shorn
seek		sought	rise, rose, risen
beseech	Is formed	besought	give, gave, given
think		thought	strive, strove, striven
work		wrought	sing, sang, sung
buy		bought	know, knew, known
grinde		ground	throw, threw, thrown
stand		stood	go , went, gone ,

Of these, see more in my School Pastime.

CHAP.

CHAP. V.

Of Adverbs, Conjunctions, Prepositions,
and Interjections.

AN *Adverb* is a Word joyned to a Verb
or Noun, to declare their Signification.
Some of Time, as *when, now, then, to day.*
Some of Number , as, *how oft, once, twice.*
Some of Order, as, *first, next, afterward.*
Some of Place, as *where, here, there.*
Some of Affirming , as , *yea, perhaps.*
Some of Denying , as , *no, not.*
Some of Shewing , as , *lo, behold.*
Some of Similitude , as, *so, how much, more.*

A *Conjunction* is a part of Speech , which joyn-
eth Words and Sentences together , of which
these are some , *And, also, likewise, nor, neither,*
whether, or, either, but, for , &c.

A *Preposition* , is a Word commonly set be-
fore other parts of Speech , either in apposition,
as *before the Master,* or in composition, as *over-*
wise.

An *Interjection* is a Word , expressing some
suddain passion of the Mind, *oh, alass, O strange,*
ho, hark, sirrah.

CHAP. VI.

Of Dividing of Words into Syllables.

FOr the dividing of Words into Syllables there are four Rules.

1. Two Vowels which make no Dipthong, muſt be divided; as, *ie, iu, ua*; as in *qui-et*, *tri-umph*, *mutu-al*.

2. Thoſe Conſonants which are doubled in the middle of a Word, muſt be divided; as in *Abba, accord, adder.*

Except they be needleſly doubled, as in words of the *Plural Number*; as in *crabbs, rodds.*

Except ſuch words in which they are doubled for diſtinction ſake; as in the words, *Ann, Cann, Inn.*

3. *Rule.* When a Conſonant cometh between two Vowels, it is to be joyned to the latter; as in *a-vail, a-ni-mate.*

But to this Rule there are four Exceptions.

1. Except Words ending in *es*, as in *Nouns* of the *Plural Number*, and *Verbs* of the *third perſon Singular*, in which this particle is for the moſt part ſwallowed up, in the former Syllable; but in all proper Names, except *Charles* and *James*, it makes a diſtinct Syllable.

2. Except Words that are compounded of ſuch Simple Words, as are ſignificant apart, in which each Simple Word muſt retain its own letters; as, *Trades-man, ſafe-guard, hence-forth.*

C   3. Ex-

3. Except *Derivative* Words, whose addition to the *Primitive*, doth signifie nothing of it self, in which the *Primitive* must be sounded by it self, and the addition by it self; as, *hope-less*, *lov-ing*, *joyn-ing*, and such like.

4. Except such Words in which *x* cometh between two Vowels, in which it must be joyned to the first Vowel; as, *ox-en*, *ex-ercise*.

4. *Rule.* Any two or three Consonants, which may be joyned together in the beginning of a Word, are not to be separated in the middle; as in *a-gree*, *be-stow*, *en-thrall*, *de-struction:* but, in compounded Words, each simple Word must retain its own Letters.

When you are to write any hard long Word, mark how many sounds or Syllables it hath, as if you were to write *disdainfullness*, *univer-salitie*, or the like, before you write it; say thus to your self, *dis-dain-ful-ness*, *u-ni-ver-sa-li-tie*, and you shall hardly miss in the writing thereof.

CHAP. VII.

Of Sentences, and such Distinctions, and Points as are to be used in writing, and observed in Reading.

A *Sentence*, is a number of Words, joyned together in perfect Sense.

The Stops or Points to be observed in *Senten-*

ces,

ces, are of two forts, *Primary*, and *Secondary*.
The *Primary* Points are these Eight.

A *Comma*, is made with a little stroke
thus (,) parting of two Vowels, which otherwise
viz. A *Colon*, made with two points thus (:)

A *Semi-colon*, made with a point, and a
little stroke under it thus (;)

A *Period*, made with a single point
thus (.) and is to be used with a Parenthesis,
made thus (-) and is to be used with

An *Erotesis* or *Interrogation*, made in this
manner (?) and the other part beginneth the next

6. An *Ecphonesis*, or note of *Admiration*,
whose note is a perpendicular right line, with
a point under it thus (!)

7. A *Parenthesis*, is a note like two half
Moons, inclosing a Sentence, which may be
used or omitted, and yet the sense remain in-
tire, thus ( ).

A *Paranthesis*, is a note, which doth include
a Word which is opposed to another Word,
and is made with two *Semiquadrats*, thus [ ]
hand, and the other towards the left, and is

The *Secondary* Points are these Six.

An *Apostrophe*, which is a note set on
the top or side of a Letter, whereby two
Syllables are contracted into one, and is made
like a *Comma*, thus (') as *it's* for *it is*.

2. An *Eclipsis*, which is a note cutting off
one or more Words in the beginning or ending
of a Verse or Sentence, used in our Writing,
and is made with a long stroke thus — as

————————— *Princes are not wise ,*
Who sleep themselves , and trust their servants Eyes.

3. A *Diæresis ,* which is a note for the par-
ting of two Vowels , which otherwise might
seem to make a *Diphthong ,* and is made with
two pricks over the two Vowells, thus , (··)
as in *Laïs.*

4. An *Hyphen ,* which is a note of continu-
ation , made thus (-) and is to be used when
one part of a word concludeth the former line ,
and the other part beginneth the next ; or else,
when two words are , by way of Elegancy , as
it were joyned into one ; as *self-love ,* for the
love of ones self.

5. An *Accent ,* which is a small stroak drawn
slopewise towards the left-hand, thus , (´) and
is to be set over that Syllable in a Word ,
which is to be pronounced long.

6. A *Circumflex ,* which is the joyning toge-
ther of two oblique stroaks into one figure ,
one of them being made towards the right
hand , and the other towards the left , and is
to be set over a Vowel , thus , (â) which is
to be pronounced long , as in *bite, wile, stile ,*
not in *bit, will, still.*

The *Accent* in Words of many Syllables is
commonly placed on the third Vowel from the
last ; as in *toleration, industry.*

But Words ending in (*ary*) have the accent
on the first Syllable ; as *temporary ;* Words that
have many Consonants in the last Syllable save
one , have their accent on that Syllable , as in
                                                   eternal ;

eternal; Words ending in *ire* and *ure*, have their accent in that Syllable; as *inûre*.

A *Noun* hath its accent in the first; a *Verb* in the last Syllable; as *ábsent*, to *absént*.

So *Húmane*, when it comes before a *Substantive*, as *húmane-learning*; but in the last Syllable, when it comes after a *Substantive*, as *Christ had two natures*, the one *divíne*, the other *humàne*.

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THE *ENGLISH*
ACADEMY,
The *SECOND PART.*

OF ARITHMETICK.

CHAP. I.

Of Single Arithmetick in whole Numbers.

Arithmetick is the art of accompting by Numbers; it is either *pofitive* or *negative.*

2. *Pofitive Arithmetick,* is that which is wrought by certain and infallible Numbers at firft propounded; and this is either *fingle* or *comparative.*

3. *Single,* which is wrought by Numbers, confidered alone, without relation to one another, and this either in whole Numbers, or in Fractions.

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4. The parts of *single Arithmetick*, are two, *Notation* and *Numeration*.

5. *Notation* hath two parts; the first sheweth the value of the Notes, by which all Numbers are expressed; the second sheweth how to read the Numbers which are expressed by those Notes.

6. The Notes or Characters, by which all Numbers are usually expressed are these, 1. *one*, 2. *two*, 3. *three*, 4. *four*, 5. *five*, 6. *six*, 7. *seven*, 8. *eight*, 9. *nine*, 0. *nothing*.

7. These Notes are either significant Figures, or a Cypher.

8. The significant Figures, are the first nine, *viz.* 1, 2, 3, 4, 5, 6, 7, 8, 9. The first whereof is more particularly termed an *unite* or *unitie*, the rest are said to be composed of *unities*; so 2, is composed of two *unites*; 3, of three *unites*, &c.

9. The *Cypher*, though it signifie nothing of it self, yet being set before or after any of the rest, increaseth or decreaseth their value, as shall be further shewed hereafter.

10. The second part of *Notation*, is the reading of the Number expressed by these Notes; and this is done by distinguishing the Number given into Degrees and Periods.

11. The Degrees are three, the first is that first place of a Number towards the right hand, and is the place of Unity. The second is the second Figure towards the right hand, and this is the place of Tens. The third is the third Figure towards the right hand, and is the place

place of Hundreds; fo this Character 9, doth fignifie Nine; thefe Notes 27, Twenty feven; and thefe 235, Two hundred thirty five.

12. A *Period*, is when a number confifting of more Notes than three, hath each three Notes thereof (beginning at the right hand) diftinguifhed by Points or Commas : The feveral parts of the Numbers fo diftinguifhed, are called *Periods*; fo the Number 38156249, being diftinguifhed into *Periods*, will ftand thus, 38.156.249. of which the firft Period is read thus, Two hundred forty nine; the firft Figure in the fecond Period is the place of Thoufands, the fecond Tens of Thoufands, and the third Hundreds of Thoufands. In the third Period, the Figure is in the place of Millions, the fecond Tens of Millions, and fo this Number is thus to be read. Thirty Eight Millions, One Hundred Fifty Six Thoufand, Two Hundred Forty Nine.

13. *Numeration*, is that which by certain known Numbers propounded, doth difcover another Number unknown.

14. *Numeration* hath four Species; *Addition*, *Subtraction*, *Multiplication*, and *Divifion*.

15. *Addition*, is that by which divers Numbers are added together, to the end that the Sum or Total may be difcovered. For which purpofe, having placed the Numbers as in the following Example, begin with thofe in the Unity place firft, then with thefe in the place of Tens, then of Hundreds, and fo forward, according as the Numbers given do con-

fist of places, carrying the Tens, if there be any, to the place of the next greater rank, as Here you see.

472961	3814527
341608	4567890
74325	6549238
6739	816365
895633	15748020

16. *Subtraction* is that, by which one Number is taken out of another, so that the Residue or remainder may be known. To perform this, you must rank your Numbers, and begin as in *Addition*; and in case any of the Figures of the Number to be Subtracted shall be greater than that, from whence the Subtraction is to be made, you must borrow one from the next place above it; as in the Examples following.

895633	6549238
341695	3814527
553938	2734711

17. *Multiplication*, is that by which we Multiply two Numbers, the one by the other, to the end, that their Product may be discovered.

18. *Multiplication* hath three Parts, the *Multiplicand*, the *Multiplicator*, and the *Product*.

19. *Multiplication*, is Single or Compound.

20. Single *Multiplication*, is when the Multiplicand,

tiplicand, and Multiplicator, do each of them
consist of one only Figure; as if 9 were given
to be Multiplied by 6, 9 is the Multiplicand,
6 is the Multiplicator, and 54 is the Product.

21. Compound *Multiplication*, is when the
Multiplicator and Multiplicand do either, or
both consist of more Figures than one.

22. When the Product of any of the par-
ticular Figures shall exceed ten, place the Ex-
cess under the Line, and for every ten that it
so exceeds, keep in mind one to be added to
the next rank: *Example*; 76147, being to
be Multiplyed by 5, the Product
is 180735, and 39634 being gi-
ven to be Multiplyed by 47, the
work will stand as in the Mar-
gin, where the Product by 7
is 277438, and the Product
thereof by 4, is 158536, and
the Sum of these two Products
is 1862798.

$$
\begin{array}{r}
39634 \\
47 \\
\hline
277438 \\
158536 \\
\hline
1862798 \\
\hline
\end{array}
$$

23. *Division* is that by which we discover
how often one Number is contained in another,
that we may find out the Quotient.

24. *Division* hath three Parts, the *Dividend*,
the *Divisor*, and the *Quotient*; thus, if 35 were
given to be Divided by 5, 35 is the Dividend,
5 the Divisor, and 7 will be found to be the
Quotient.

25. In *Division*, make a crooked line at each
end of your Dividend, that on the left hand
serving for your Divisor, and that on the right
for

for the Quotient; then see how oft your Divi-
sor is contained in the first Figure or Figures of
your Dividend, and put the answer in the Quo-
tient, then Multiply your Divisor by the Fi-
gure in the Quotient, and the Product Sub-
tract from your Dividend, then draw down
the next Figure of your Dividend, and ask
how oft your Divisor may be found in the re-
mainer so increased, and the answer put in the
Quotient, and proved as before, till there be
no Figures left in your Dividend, and so oft
as the Question is repeated, so many places
must be in the Quotient, as is manifest by the
following Example.

1	047	) 1862798 (39634
2	094	141
3	141	452
4	188	423
5	235	297
6	282	282
7	329	159
8	376	141
9	423	188
		188
		0

Let 1862798, be given to be divided by 47,
I ask how often 47 may be had in 186? the
Answer is 3, which I place in the Quotient,
then I Multiply 47 by 3, the Product is 141,
which being Subtracted from 186, the Remai-
ner

ner is 45, to which draw down 2 the next Figure in the Dividend, and then it will be 452, now then I ask how often 47 may be had in 452? the which by the Table made by the continual Addition of 47 unto it self, is 9 lines, therefore I place 9 in the Quotient, and the Product of 47 is 423, which being Subtracted from 452, the Remainer is 29, to which I draw 7 the next Figure, and then proceed as before, and so at last I find the Quotient to be 39634.

26. *Multiplication* and *Division*, prove one another, for if you Multiply the Quotient by the Divisor, the Product will be equal to the Dividend: so 39634, being Multiplied by 47, the Product is 1862798, and this Product being Divided by 47, the Quotient is 39634.

CHAP.

CHAP. II.

Of Single Arithmetick in Fractions.

Single Arithmetick in whole Numbers, hath been shewed in the last Chapter; *Single Arithmetick* in Fractions now followeth.

2. A *Fraction* is a part of an Integer.

3. *Single Arithmetick* in Fractions, doth also consist of two Parts, *Notation*, and *Numeration*.

4. *Notation* of Fractions, is that which sheweth how the Fraction part of any Integer may be expressed in numbers; that is, an Integer or one whole thing being Divided into any Number of equal parts, Notation sheweth how these parts may be expressed; as if a Yard were Divided into four parts, and it were desired, that I should set down three of these parts; the usual manner is thus, draw a line, and set the Number of parts into which the Integer is supposed to be Divided, under the line, and the number of parts you would express set above the line, thus to express three, or four parts, I write 4 under a line, and 3 above it, thus, $\frac{3}{4}$; and so may you do with any other number propounded: Where note, that the number above the line is called the Numerator, and the number under the line the Denominator.

5. A *Fraction* is either *Proper* or *Improper*.

6. A *Proper Fraction* is that whose Numerator
tor

tor is less than the Denominator, such as are
these $\frac{2}{4} \frac{8}{12} \frac{11}{100}$.

7. A *Proper Fraction* is either *single* or *compound.*

8. A *Single Fraction* is that which consists of
one Numerator and one Denominator, such as
are $\frac{2}{4} \frac{4}{12} \frac{11}{100}$.

9. A *Compound Fraction* (otherwise called a
Fraction of a Fraction) is that which hath more
Numerators and more Denominators than one,
which kind of Fractions are discoverable by this
word (*of*) which is interposed between their
parts; as, $\frac{2}{3}$ of $\frac{3}{4}$ is a Fraction of a Fraction,
or a Compound Fraction, and expresseth two
thirds of three fourths of an Integer.

10. The things expressed by broken Numbers or Fractions, are principally the Parts or
Fractions of Money, Weight, Measure, Time,
and things accounted by the Dozen.

11. The least part or Fraction of Money
used in *England* is a Farthing; and four Farthings makes a Peny; twelve Pence, a Shilling;
and twenty Shillings, one Pound Sterling.

12. The least Fraction of Weight used in
England, is a Grain; that is, the Weight of a
Grain of Wheat well dryed and gathered out
of the middle of the Ear, whereof 32 make
a Peny Weight, and twenty Peny Weight an
Ounce *Troy*, and twelve Ounces a Pound: but
a Peny Weight being thus ascertained, it is
now subdivided into twenty four Grains.

13. The Weights used by *Apothecaries* are
derived from a Pound *Troy*, which is subdivided in this manner. ℔ A

℔ A Pound *Troy*, is ⸺ 12 Ounces.
℥ An Ounce, is ⸺ 8 Drams.
Ʒ A Dram, is ⸺ 3 Scruples.
Ə A Scruple, is ⸺ 20 Grains.

14. Besides *Troy* Weight, there is another kind of Weight used in *England*, called *Averdupois* Weight, a Pound whereof is equal to fourteen Ounces, twelve peny Weight *Troy*, the which is subdivided into 16 Ounces, each Ounce into 16 Drams, and each Dram into 4 Quarters. Of this Weight 112 makes a Hundred.

15. The Measures used in *England* are of Capacity or Length.

16. The Measures of Capacity are liquid or dry; Liquid Measures are according to this Table.

One pound of Wheat }
   Troy Weight ⸺ } One Pint.
Two Pints   One Quart.
Two Quarts   One pottle.
Two Pottles   One Gallon.
Eight Gallons   One Firkin of Ale.
Nine Gallons   One Firkin of Bear.
Two Firkins   One Kilderkin.
Two Kilderkins   One Barrel.
Forty two Gallons   One Tearce of wine
Sixty three Gallons   One Hogshead.
Two Hogsheads   One Pipe or Butt.
Two Pipes   One Tun.

17.

17. Dry Measures are those in which all kind of dry substances are Meted; as Grain, Sea-coal, Salt, and the like; their Table is this that followeth.

One Pint		One Pint.
Two Pints		One Quart.
Two Quarts		One Pottle.
Two Pottles		One Gallon.
Two Gallons	*Makes*	One Peck.
Four Pecks		1 Bushel land measure.
Five Pecks		1 Bushel water measure.
Eight Bushels		One Quarter.
Four Quarters		One Chaldron.
Five Quarters		One Wey.

18. Long Measures are expressed in the Table following.

Three Barley-Corns in length		One Inch.
Twelve Inches		One Foot.
Three Foot		One Yard.
Three Foot 9 Inches	*Make*	One Ell.
Six Foot		One Fathom.
Five yards and an half		One pole or pearch.
Forty Poles		One Furlong.
Eight Furlongs		One *English* Mile.

Note that a Yard, as also an Ell is usually sub-
D   divided

divided into Four Quarters, and each Quarter into four Nails.

19. A Table of Time is this that followeth.

Sixty Minutes		One Hour.
Twenty four Hours	Make	One Day natural.
Seven Dayes		One Week.
Four Weeks		1 month of 28 dayes.

Fifty two Weeks, One Day, and Six Hours, make One Year.

And thefe Fractions of Money, Weight, Meafure, &c. are ufually written under their feveral Denominations, inftead of having their Denominators written under them thus;

| lib. | fhill. | pence. | farth. |
| 23. | 19. | 08. | 3. |

And as their Notation is two fold, fo is their Numeration alfo; Firft, then I will fhew you the Numeration of parts when written, as Integers, and then as vulgar Fractions.

20. Numeration of parts when written, as Integers, is Accidental or Effential.

21. *Accidental Numeration*, otherwife called *Reduction*, is either Defcending or Afcending.

22. *Reduction Defcending*, is when a Number of greater Denomination being given, it is required, to find how many of a lefter Denomination, are equal in value to that given

Number

Number of the greater. And this is performed by *Multiplication*; as if it were required to Reduce 329 Shillings into Pence, if you Multiply 329 by 20, the number of Shillings in a Pound, the Product will be 6580 Shillings, and 6580 shillings being Multiplied by 12, the number of Pence in a Shilling, the Product will be 78960 Pence.

23. *Reduction Ascending*, is when a Number of a lesser Denomination being given, it is required, to find how many of a greater Denomination, are equal to that given Number of the lesser: And this is done by *Division*, as if it were required to find how many Pounds there were in 78960 Pence; if 78960 Pence be Divided by 12, the Number of Pence in a Shilling, the Quotient will be 6580 Shillings, and if 6580 Shillings be Divided by 20, the Number of Shillings in a Pound, the Quotient will be 329 Pounds, and so for any other.

24. *Essential Numeration*, doth consist of four Species, *Addition, Subtraction, Multiplication, and Division.*

25. In *Addition* of Numbers of several Denominations, you must begin with the least first, and when the sum of any of the Denominations amounts to an Integer, add it to the next Denomination that is greater.

Example.

```
23 : 14 : 10 : 1        15 : 18 : 10
16 : 15 : 09 : 2        16 : 17 : 09
27 : 09 : 11 : 1        17 : 16 : 08
44 : 19 : 07 : 3        18 : 15 : 07
――――――――――――――         ――――――――――――
113 : 00 : 02 : 3        69 : 08 : 10
```

26. In *Subtraction* of Numbers of several Denominations, when any of the parts of the greater Number are less than the parts of the lesser Number subscribed, Deduct the parts of the lesser Number from the parts of the greater, increased with an Integer, of the next superiour Denomination, and keeping one in mind, add to the next place of the Number given to be Subtracted.

Example.

```
44 : 13 : 07 : 1        69 : 08 : 07
25 : 19 : 11 : 3        42 : 19 : 11
――――――――――――――         ――――――――――――
18 : 13 : 07 : 2        26 : 08 : 08
```

27. In *Multiplication* of Numbers of several Denominations, you must first reduce the Numbers given to their last Denominations and then Multiply them as hath been shewed in whole Numbers, the Product Divided by the Square of the parts of an Integer, reduced
to

to the laſt Denomination, ſhall in the Quotient give the Product required.

Example.

Let the Product of 17 *l.* 19 *s.* 6 *d.* by 5 *l.* 13 *s.* 6 *d.* be required. 17 *l.* 19 *s.* 6 *d.* being reduced to make 4314 *Pence.* And 5 *l.* 13 *s.* 6 *d.* reduced do make 1362 *Pence.*

The Multiplicand.	4314
The Multiplicator.	1362

$$8628$$
$$25882$$
$$12942$$
$$4314$$

The Product. 5875668

The Number of Pence in a Pound are 240, and the Square thereof is 57600, by which Dividing 5875668 the Quotient; 102 *lib.* 00 *ſhill.* 01 *peny.* 3 *farthings*, and $\frac{4628}{57600}$ is the Quotient ſought.

28. In *Diviſion* of Numbers of ſeveral Denominations, firſt reduce your Diviſor to its Number of parts in the leaſt Denomination, then Multiply your Dividend, by the Square of the parts in an Integer reduced to the leaſt Denomination; and if there be any parts annexed, to the Integers of the Dividend, they muſt be reduced to the higheſt Fraction, that

the

the Square of the parts in an Integer reduced to its leaſt Denomination will bear, and added to the former Product, the whole being divided by your Diviſor reduced, will give you the Quotient ſought.

Example.

Let 102 : 00 : 01 : 3 $\frac{4608}{1760}$ be given to be Divided by 5 : 13 : 6. Firſt I reduce the Diviſor given to its Number of parts in the laſt Denomination, and it makes 1362 Pence, then I Multiply 102 the Integral part of my Dividend, by 57600, the ſquare of Pence in a Pound, the Product is 58752, and the Fraction of my Dividend 00 : 01 : 3 $\frac{4608}{3760}$ being reduced, is $\frac{4608}{57600}$, which being added to the former Product 58752, the Sum is 5875668, for the Dividend; which being divided by 1362, the Quotient is 4314 *pence*, that is 17 *lib.* 19 *ſhill.* 6 *pence.*

29. *Numeration* of Fractions, when written with their Numerators and Denominators, is alſo Accidental and Eſſential.

30. *Accidental Numeration*, otherwiſe called *Reduction*, is three-fold.

1. To Reduce one Fraction which is not already in its leaſt terms, to a leſſer Denomination.

To do this, divide the Numerator and Denominator by their greateſt common meaſure, the two Quotients ſhall be one of them, a new Numerator, and the other a new Denominator

of

of a Fraction equal to the Fraction given, and in its least terms.

Example $\frac{21}{117}$ being given to be Reduced, the greatest common measure is 13, by which Dividing 91, the Quotient is 7, for a new Numerator, and Dividing 117 by 13, the Quotient is 9 for a new Denominator, and so $\frac{21}{117}$ is reduced to $\frac{7}{9}$.

The greatest common measure between two Numbers is found thus; Divide the greater Number by the less, and your Divisor by the Remainer, if there be any, your last Divisor is the common measure sought, as in the following Example.

$$
\begin{array}{r}
91\ )\ 117\ (1 \\
91 \\
\hline
26)\ 91\ (3 \\
78 \\
\hline
13\ )\ 26\ (2 \\
26 \\
\hline
0
\end{array}
$$

2. To Reduce many Fractions of divers Denominations into one Denomination.

To do this, Multiply each Numerator by all the Denominators except its own, the Products shall be the new Numerators, then Multiply all the Denominators together, and the Product shall be the common Denominator sought.

Ex-

Example. $\frac{2}{3}$ $\frac{4}{5}$ $\frac{6}{7}$ will be reduced to $\frac{70}{105}$, $\frac{84}{105}$ $\frac{90}{105}$.

3. To Reduce any Fraction from one Denomination, to any other Denomination defired. And to do this Multiply the Numerator given, by the Denominator required, and Divide the Product by the Denominator given, the Quotient fhall be the Numerator defired.

Example, let it be defired to Reduce $\frac{17}{20}$ to a Fraction, whofe Denominator fhall be 100, firft Multiply 17 by 100, the Product is 1700, which being Divided by 20, the Quotient is 85, for the new Numerator defired.

31. Effential Numeration of Fractions hath four Species, *Addition*, *Subduction*, *Multiplication* and *Divifion*.

32. In Addition of Fractions, the Fractions given muft be firft Reduced to one Denomination, and then add the Numerators together, fo have you the Sum of the Fractions, fo $\frac{2}{9}$ and $\frac{1}{9}$ make $\frac{3}{9}$.

33. Subtraction of Fractions is thus, if of one Denomination, Deduct the lefs from the greater, their difference is the remainer, fo $\frac{2}{9}$ taken from $\frac{7}{9}$ reft $\frac{5}{9}$.

34. Multiplication of Fractions, is thus, Multiply all the Numerators together, fo is their Product a new Numerator, then Multiply all the Denominators together, and their Product is a new Denominator.

Thus if $\frac{2}{3}$ and $\frac{1}{8}$ were to be Multiplied, the Product will be $\frac{2}{96}$.

35. Divifion of Fractions is thus, Multiply the

the Numerator of the Dividend by the Denominator of the Divisor, the Product shall be a new Numerator; also Multiply the Numerator of the Divisor, by the Denominator of the Dividend, so shall the Product be a new Denominator, and this new Fraction is the Quotient sought; so if $\frac{4}{5}$ were to be Divided by $\frac{1}{5}$, the Product will be $\frac{12}{27}$.

36. When the Denominator of a Fraction is an Unite with Cyphers, the Fraction is more particularly called a Decimal; and such Fractions may be expressed without their Denominators as well as with them, thus, $\frac{1}{10}$ may be written thus, 5.

37. When the Numerator doth not consist of so many Places, as the Denominator hath Cyphers, fill up the void places of the Numerator with Cyphers, so, $\frac{5}{100}$, $\frac{25}{1000}$, are written thus, .05, and .025.

38. Numeration of Decimal Fractions, is likewise two fold, Accidental and Essential.

39. Accidental Numeration, otherwise called Reduction, is performed, by the third way of Reduction, shewed in the Twenty seventh Rule of this Chapter.

40. Essential Numeration, hath in it the four usual Species, *Addition, Subtraction, Multiplication*, and *Division*.

41. Addition of Decimals is the same with Addition of whole Numbers, if a point or line be set between the Integers and the Parts, as in the following Examples.

2.00741

2.00741	23.05678
.74258	16.14365
.96314	32.76108
3.71313	71.96151

42. Subduction of Decimals doth differ
from Subduction in whole Numbers, but by a
point to distinguish the whole Number from
the broken; as in the Example following.

25.07496	36.01436
17.89637	17.83589
7.17859	18.17847

43. Multiplication of Decimal Fractions,
is the same with Multiplication in whole Num-
bers, but when the work is finished, to di-
stinguish the Integers from the Decimals, do
thus; so many places of parts as are in both
the numbers given, being separated by a point,
the rest of the Figures towards the left hand are
Integers, and those towards the right are De-
cimal parts; as in these Examples.

12.45	17.37
7.08	3.72
9960	3474
87150	12159
	5211
88.1460	64.6164

44.

44. Division of Decimal Fractions is the same with Division in whole numbers, but when the Work is finished, to distinguish the Fractional part from the Integers, observe this general Rule.

The first Figure in your Quotient will be alwayes of the same degree or place with that Figure or Cypher in your Dividend, which standeth over the Unites place in your Divisor.

For Example : 78925, being given to be divided by 32, the Quotient will be 2466, and because the place of Unites in the Divisor, doth stand under the place of seconds in the Dividend, therefore the first Figure in the Quotient, will be in the place of seconds, and the first must be supplied with a Cypher, and then the Quotient will be 0.02466.

CHAP.

CHAP. III.

Of Comparative Arithmetick.

THus much hath been said concerning Single Arithmetick, Comparative follows, which is wrought by Numbers, as they are considered to have relation to one another.

2. This Relation consists either in Quantity or in Quality.

3. Relation in Quantity is the reference that the Numbers themselves have one to another; as when the Comparison is made between 8 and 2, or 2 and 8; 7 and 3, or 3 and 7.

And here the Numbers propounded are alwayes two, whereof the first is called the Antecedent, the other the Consequent.

4. Relation in Quantity, consists either in the difference, or in the rate or reason found between the Numbers propounded; the one is found by Subtracting the less from the greater; so 6 is the difference between 8 and 2; but the other, to wit, the rate or reason, is found by Dividing the greater by the less, and thus the rate between 8 and 2 is four-fold, because 2 is found four times in 8; Or the rate may be also found by Dividing the less by the greater, or setting the Numbers given in manner of a Fraction, and thus the rate between 2 and 8 is 4 also, or $\frac{2}{8}$ that is $\frac{1}{4}$.

5. This rate or reason of Numbers is either Equal or unequal; Equal reason, is the relation
that

that Equal Numbers have one to another, as 5 to 5, 6 to 6. Unequal Reason is the relation that Unequal Numbers have one to another, and this is either of the greater to the less, or of the less unto the greater.

In the one the greater Number is the Antecedent, and the less the Consequent; and in the other the lesser Number is the Antecedent, and the greater is the Consequent.

6. Relation in Quality, (otherwise called Proportion) is the reference or respect that the reasons of Numbers have one to another, and therefore the numbers must be more than two, or else there cannot be the comparing of reasons in the Plural Number.

7. Proportion is two fold, Arithmetical and Geometrical.

8. Arithmetical proportion, is when Numbers differ according to equal reason; that is, have equal differences; as, 2, 4, 6, 8, 10, or 3, 6, 9, 12, in the first rank the common difference is 2, and in the second 3.

9. Arithmetical proportion, is either continued, or interrupted.

10. Arithmetical proportion continued, is when divers numbers are linked together by a continued Progression of equal difference: and in such a Progression, the sum of the first and last Terms being Multiplied by half the number of the Terms, the Product will be the sum of all the Terms; as in this Progression, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, the sum of the first and last is 13, which being Multiplied

plied by 6, half the number of the Terms,
the Product is 78, the sum of all the terms in
that Progression.

11. Three Numbers being given in Arithme-
tical proportion, the Mean number being dou-
bled is equal to the sum of the Extreams; so
3, 6, 9, being given, the double of 6, the
mean number is equal to the sum of 3 and 9,
the two Extreams.

12. Arithmetical Proportion interrupted,
is when the Progression is discontinued, as in
these numbers, 2, 4, 8, 10.

13. In Arithmetical Proportion continued
or discontinued, the sum of the Means is equal
to the sum of the Extreams, as in 3, 6, 9, 12,
being given, the sum of 6 and 9 is equal to the
sum of 3 and 12, or 3, 6, 12, 15, being gi-
ven, the sum of 6 and 12, is equal to the sum
of 3 and 15.

14. Geometrical Proportion is, when di-
vers numbers differ by the like reason; as, 1,
2, 4, 8, 16, which differ one from another by
double reason; for as 1 is the half of 2, so 2 is
the half of 4, 4 of 8, 8 of 16.

15. Geometrical proportion is either conti-
nued or interrupted, Geometrical proportion
continued, is when divers numbers are linked
together, by a continued Progression of the
like reason; as, 1, 2, 4, 8, 16, or 3, 6, 12,
24, 48.

16. In Numbers Geometrically proportional,
If you Multiply the last Term by the common
rate by which they differ, and from the Pro-
duct

duct Deduct the first Term, and Divide the Re-
mainer by the former rate less by an Unite, the
Quotient shall be the sum of all the Progressi-
ons ; So 2, 6, 18, 54, 162, 486, 1458, being
propounded the last Term 1460, being multi-
plied by 3 the rate, the Product is 4374 out of
which deducting 2 the first Term, the Remainer
is 4372, which being Divided by 2 the rate less
one, the Quotient 2186 is the sum of that
Progression.

17. Three Proportionals being given, the
Square of the Mean is equal to the Product of
the Extreams ; so 4, 8, 16, being given, the
Square of 8 is equal to four times 16.

18. Geometrical Proportion interrupted,
is when the Progression of like reason is discon-
tinued; as, 2, 4, 16, 32, where the Term be-
tween 4 and 16 is wanting, and therefore the
rate between 4 and 16 is not the same that is
between 2 and 4, or 16 and 32.

19. Four Proportional Numbers whatsoever
being given, the Product of the two Means is
equal to the Product of the two Extreams; so
2, 4, 16, 32, being propounded, 4 times 16 is
equal to 2 times 32, which is 64.

CHAP.

CHAP. IV.

Of the Rule of Proportion, or Rule of Three.

FRom the laſt Rule of the former Chapter ariſeth that precious Gem in Arithmetick, the *Rule of three*, which for its excellency, deſerves the name that is given to it, *The Golden Rule.*

2. *The Golden Rule*, is that by which certain numbers being given, another number Geometrically proportional to them may be found out.

3. The *Golden Rule* is either Single or Compound.

4. The Single Rule, is when three terms or numbers are propounded, and a fourth in proportion to them is deſired.

5. The Terms of the Rule of Three conſiſt of two Denominations; two of the Terms propounded have one Denomination, the third propounded and fourth required, have another.

6. Of thoſe two numbers given which are of one Denomination, that which moves the Queſtion muſt poſſeſs the third place, the other number of the ſame Denomination, muſt be put in the firſt place, and conſequently, the other known Term, which is of the ſame Denomination with the fourth required, muſt poſſeſs the ſecond place.

7. The three Terms propounded being thus placed,

placed, confider whether your third doth require more or lefs; if it requires more, Multiply the middle number by the greater of the two Extreams, and Divide the Product by the leffer, the Quotient is the fourth Number or Term defired.

But if the third Term in the Queftion require lefs, Multiply the middle Term by the leffer of the two Extreams, and the Product Divide by the greater, the Quotient fhall be the fourth Term defired; An Example in each Cafe will fufficiently explain the Rule.

If 7 Pound of Sugar coft 2 s. 7 d. What fhall 28 Pound of Sugar coft? The Terms muft ftand thus,

℔ *fugar.*	s.	d.	℔ *fugar.*
7	2	7	28

Where it is plain, that 28 pound of Sugar muft needs coft more than 7, therefore I Multiply 2 s. 7 d. or 31 *pence*, by 28, the Product 868 being Divided by 7 and the Quotient is 124 d. or 10 s. 4 d.

2. *Example:* If 7 Men will digg a Garden in 31 Dayes; In how many Dayes will 28 Men digg the fame Garden? Here the Terms muft ftand thus,

Men.	Dayes.	Men.
7	31	28

E   And

And by the state of the Question it plainly
appears, that the third Term requireth less:
therefore I Multiply 3 1, the middle Term, by
7, the lesser Extream, and the Product 217
being Divided by 28, the Quotient $7\frac{11}{28}$ is the
fourth Term desired.

CHAP. V.

Of the Compound Rule of Three.

THe *Compound Rule of Three*, is when more
than three Terms are propounded.

2. Under the *Compound Rule of Three* is
comprehended the *Double Rule of Three*, and
divers Rules of plural proportion.

3. The *Double Rule of Three*, is when five
Terms are propounded, and a sixth in proportion
to them is required.

4. In this Rule the five Terms given do con-
sist of two parts; first a Supposition, and then
a Demonstration; the Supposition is expressed
by three of the Terms propounded, and the
demand by the other two.

5. And here the greatest difficulty is in pla-
cing of the Terms; for which observe amongst
the Terms of Supposition, which of them hath
the same Denomination with the Term requi-
red, reserve that for the second place, and
write

write the other two Terms in the Suppofition one above another in the firft place ; and laftly, the Terms of Demand one above another, likewise in the third place, in fuch fort, that the uppermoft may have the fame Denomination with the uppermoft of thofe in the firft place.

Example.

If 6 Clerks can write 45 fheets of Paper in 5 Dayes ; How many Clerks can write 300 fheets in 72 Dayes ? Here the Queftion is concerning the number of Clerks, the 6 Clerks muft therefore poffefs the fecond place, and the Dayes and Paper in the Suppofition muft be fet in the firft, one over the other, of which, if Paper be the uppermoft in the other Terms, the Paper muft be fet over the Dayes in the third place, and then the Number in the Queftion will ftand thus,

$$45 \longrightarrow 6 \longrightarrow 300$$
$$5 \qquad\qquad 13$$

6. The Terms propounded being thus placed, the Queftion may be refolved by two Single Rules of Three, in this manner.

1. As the uppermoft Term of the firft place is to the middle, fo is the uppermoft Term in the laft place to a fourth Number.

2. As the lower Term of the firft place is to that fourth Number, fo is the lower Term of the laft place to the Term required.

But in both thefe Proportions, confidera-

tion

tion muſt be had to the Term required, name-
ly, whether it muſt be more or leſs than the
middle Term given.

In our preſent Queſtion, the fourth Term
in the firſt Proportion muſt be greater than the
ſecond; for it is plain, that more work will re-
quire more men; therefore I ſay,

<div align="center">

as 45 . 6 :: 300 . 40 Clerks.

</div>

But in the ſecond Proportion, it is likewiſe
plain, that the more Time is given, the fewer
Perſons are required; and therefore in this Pro-
portion, 5. 40. 13. I multiply the middle
Term by the firſt, and the Product 200 I divide
by 13, the laſt, and the Quotient is 15 $\frac{1 \circ}{3}$.

2. *Example :* If 100 *l.* gain 6 *l.* in 12 months,
What ſhall 276 *l.* gain in 18 months? In this
Queſtion the Terms muſt be thus placed.

<div align="center">

100 —— 6 —— 276
12   18

</div>

1.   100 . 6 :: 276 . 16 . 56.

2.   12 . 16 . 56 :: 18 . 24 . 84.

<div align="right">

CHAP.

</div>

CHAP. VI.

Of the Rule of Fellowſhip.

THe Rules of Plural proportion are thoſe,
by which we Reſolve Queſtions that are
diſcoverable by more Rules of Three than one,
and cannot be performed by the Double Rule
of Three mentioned in the laſt Chapter.

Of theſe Rules there are divers kinds and
varieties, according to the nature of the Que-
ſtion propounded; I will only mention one,
and refer the reſt to my larger Treatiſe of this
Subject.

2. The Rule of Plural proportion that I
mean to mention, is the Rule of *Fellowſhip.*

3. And the Rule of *Fellowſhip* is that by
which in Accompts amongſt divers Men, (their
ſeveral Stocks together) the whole Loſs or Gain
being propounded, the Loſs or Gain of each
particular Man may be diſcovered.

4. The *Rule of Fellowſhip* is either Single or
Double.

5. The *Single Rule of Fellowſhip* is, when the
Stocks propounded are Single numbers; As in
this Example: *A* and *B* were Partners in an
Adventure to Sea, *A* put in 25 *l.* *B* 56, and
upon return of the Ship, they ſold the Fraight
for 50 *l.* profit; the Queſtion is, What part of
this 50 *l.* is due to *A*, and what to *B?* To re-
ſolve this and the like Queſtions, the Sum of

E 3   the

the Stocks muft be the firft Term in the Rule
of Three , the whole gain the fecond , and
each particular Stock the third ; this done, re-
peating the Rule of Three , as often as there
are particular Stocks in the Queftion , the
fourth Term produced by thefe feveral opera-
tions are the refpective Gains or Loffes of thofe
particular Stocks propounded ; fo in the prefent
Queftion , the Refolution will be as here you
fee.

$$81 \cdot 50 :: \begin{array}{c} 25 \\ 56 \end{array} \Big\} \begin{array}{c} 15 \cdot 432. \\ 34 \cdot 567. \end{array}$$

6. The *Double Rule of Fellowfhip* is , when
the Stocks propounded are double numbers,
that is , when each Stock hath relation to a
particular line. *A, B,* and *C,* hire a piece of
Ground for 45 *l. per Annum* , in which *A* had
24 Oxen 32 Daies , *B* 2, for 48 Daies , *C* 16,
for 24 Daies ; now the Queftion to be refolved
is, What part of the Rent each perfon muft pay.
For this purpofe you muft firft Multiply each
particular Stock by its refpective Time, and
take the Total of their Products for the firft
Term , the Gain or Lofs for the fecond , and
every mans particular Stock and Time for the
third ; this done, repeating the Rule of Three
fo often as there are Products of the double
Numbers ; the fourth Terms produced upon
thofe feveral operations are the numbers fought.
So then in the Queftion propounded , the Pro-
duct of 24 and 32 is 768 ; the Product of

12

12 and 48 is 576, and the Product of 16 and 24 is 384, the Sum of thele Products is 1728, which is the firſt Term, 45 *l.* the Rent is the ſecond, and each particular Product the third;

$$1728 \cdot 45 :: \begin{cases} 768 \cdot 20. \\ 576 \cdot 15. \\ 384 \cdot 10. \end{cases}$$

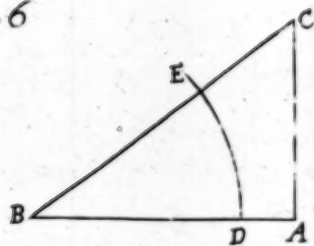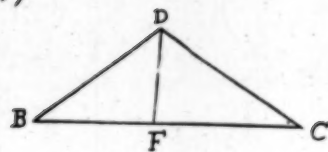By which three Operations the Queſtion is Reſolved.
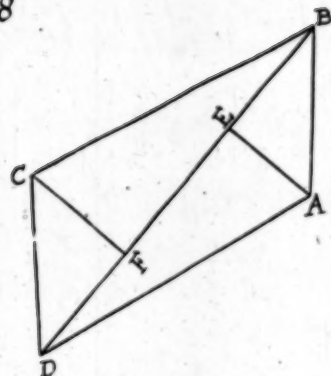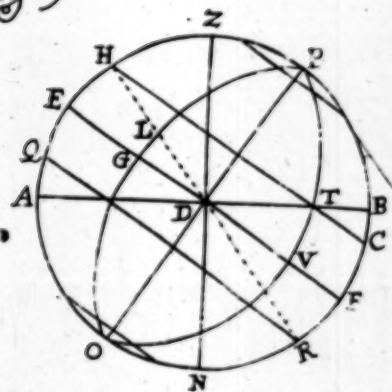
F I N I S.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

Fig. 8

Fig. 9

Fig. 10

THE *ENGLISH*
ACADEMY:
The THIRD PART.

OF GEOMETRY.

CHAP. I.

Of the Definition and Division of Geometry.

GEOMETRY is the Art of Measuring well.

2. The Subject of *Geometry* is Magnitude, or continued Quantity, whose parts are joyned together by a common Term or limit.

3. *Magnitude* is either a Line, or something made of a Line or Lines.

4. A *Line* is a Magnitude, consisting only of Length, without either Breadth or Thickness, the Term or limit whereof is a Point.

5. A

5. A *Point* is an indivisible Sign in Magnitude. A *Point* therefore is no quantity, but the beginning of all continued quantities, which are divisible in power infinitely.

6. A *Line* is either considered Simply by it self, or else comparatively with another Line.

7. A *Line* considered simply of it self, is either Right or Oblique.

8. A *Right line*, is that which lyeth equally between his Points.

9. An *Oblique line*, is either circular or mixt.

10. A *Periphery*, or Circular Line, is that which is equally distant from the middle of the comprehended space, which middle is called the *Centre*, and the distance between that Centre and the Circumference, is called the *Radius*.

11. Lines compared to one another are of the same or different Species.

12. Lines compared together of the same Species, are either Parallel or Angular.

13. *Parallel lines*, are such as are equally distant in all places, and are either Right lined Parallels, or Circular.

14. *Right lined Parallels*, are such as being in one and the self same plane, and infinitely produced on both sides, do never meet in any part.

15. A *Circular Parallel* is a Circle drawn within or without another Circle.

16. *Angular lines* are such as inclinining, or bowing to one another, touch one another, but not in a direct Line.

17. An *Angle* is either Right or Oblique.

18. A *Right Angle*, is that whose legs or sides are Perpendicular to one another.

19. An *Oblique Angle*, is that whose legs or sides do incline to one another upon one side more than upon another.

20. An *Oblique Angle* is either Acute, or Obtuse.

21. An *Acute Oblique Angle*, is that which is less than a Right.

22. An *Obtuse Oblique Angle*, is that which is greater than a Right Angle.

23. The *Measure of an Angle*, is the Arch of a Circle described upon the Angular Point, and intersected between the sides of the Angle sufficiently prolonged; but of this Measure there can be no certain knowledge, unless the quantity of that Arch be expressed in Numbers.

24. Every Circle therefore is supposed to be divided into 360 equal parts, called Degrees, and every Degree into 60 Minutes, and every Minute into 60 Seconds, and so forward; others suppose every Degree to be subdivided into 10 parts, and every one of those into 10 more, and so forward, as far as you please.

25. A *Semi-circle* is the half of a whole Circle, and containeth 180 Degrees.

26. A *Quadrant*, or fourth part of a Circle, is 90 Degrees; and seeing that a Right Line falling Perpendicularly upon a Right Line, doth make the Angles on both sides equal, and cutteth a Semi-circle into two equal parts, the
                                            fourth

fourth part of a Circle, or 90 Degrees, muſt needs be the Meaſure of a Right Angle.

27. Thus are Lines compared with Lines of the ſame Species, the comparing of Lines of different Species, is the comparing of Right Lines with thoſe that are Oblique or Circular.

28. And *Right Lines*, as they have reference to, or are compared with the Circumference of a Circle, are either ſuch as are inſcribed within it, or applyed to it.

29. A *Right Line*, inſcribed in a Circle, either paſſeth through the Centre, as the Diameter and Radius, or is drawn beſides the Centre, as Chords and Sines.

30. A *Diameter*, is a Right Line inſcribed through the Centre of the Circle, dividing the Circle into two equal parts.

31. The *Radius* of a Circle is the one half of the Diameter, or a Right Line drawn from the Centre to the Circumference; thus the Right Line *G B D*, in *Fig.* 1. is a Diameter, *G B*, or *B D*, the Radius.

32. A *Chord* or *Subtenſe*, is an inſcribed Right Line drawn through or beſides the Centre bounded at both ends with the Circumference.

33. A *Chord* or *Subtenſe*, drawn through the Centre is the ſame with the Diameter.

34. A *Chord* or *Subtenſe*, drawn beſides the Centre, is a Right Line bounded at both ends with the Circumference, but alwayes leſs than the Diameter.

35. *Sines* are either Right or Versed.

36. A *Right Sine* is half the Chord of the Double Arch, and it is either the whole Sine, and Sine of 90 Deg. or Sine less than the whole.

37. The whole Sine is equal to the Semi-diameter or Radius of a Circle, as the Right Line *B E*.

38. A Sine less than whole, is half the Chord of any Arch less than a Semi-circle; as *C A* is the Sine of *C D*.

39. A *Versed Sine*, is a part of the Diameter lying between the Right Sine and the Circumference, as the Right Line *A D*, which is one part of the Diameter, is the Versed Sine of the Arch *C D*, and the Right Line *A G*, which is the other part of the Diameter, is the Versed Sine of the Arch *C E G*.

40. A *Right line* applied to a Circle, is either a Tangent or Secant.

41. A *Tangent*, is a Right Line without but touching the Circle, drawn Perpendicular to the end of the Radius or Diameter, continued at the Secant.

42. A *Secant*, is a Right Line drawn from the Centre of the Circle, through the Term of an Arch, and continued to the Tangent; Thus the Right Line *F D*, is the Tangent, and the Right Line *B F*, is the Secant of the Arch *C D*, or of the Arch *C E G*, the Complement thereof to a Semi-circle.

43. These Lines thus inscribed in, or applied to a Circle, may to any limited Radius be drawn or made upon a Rule of Wood, Brass, or other

Metal

Metal; or, a Table may be made, expressing the Length of these Lines in numbers, answering to every Degree and part of a Degree in the Quadrant or Semi-circle; That is, the Lines of Chords and Versed Sines may be made to any part of a Semi-circle, and the Lines of Sines, Tangents and Secants, to any part of a Quadrant: The use of such Scales and Tables, that no Student in *Geometrie* can well be without them; here therefore I will lay down such Propositions as will sufficiently demonstrate the way of making these Lines upon a Scale or Ruler, but as to the construction of the Tables by which the lengths of these Lines are expressed in Numbers: I refer them to my *Trigonometria Britanica*, and other Books of the like nature.

Proposition I.

Upon a Right Line given, to erect a Perpendicular, from any Point assigned.

Let it be required to erect a Perpendicular to the Line *D G*, from the Point *B*, in *Fig.* 2. take two equidistant Points, as *D* and *G*, open your Compasses to a convenient distance, and setting one Foot of your Compasses in *B*, draw the Arch *E C*, and keeping your Compasses at the same distance, set one Foot in *G*, and with the other draw the Arch *H I F*, and through the Intersections of these two Arches draw a Right Line, as *B L*, which shall be perpendicular to the Point *B*.   But

But if it were required to erect a Perpendicular from the end of a Line, do thus, your Compasses being opened to any convenient distance, set one Foot in the Point given, as at *A*, in the Line *A B*, and the other at *D*, or where you please, and making *D* the Centre, draw the Arch *C A E*, and from the points *C* and *D*, draw the Right Line *C D E*, then draw the Line *A C*, which shall be Perpendicular to the Line *A B*, from the point *A*, as was required.

Propositivn II.

From a Point assigned without a Right Line given, to let fall a Perpendicular.

Let the given Line be *D G*, and let the point assigned be *L*, at the distance of *L D* draw the Arch *D A G F*, then setting one Foot of your Compasses in *D*, draw the Arch *I K*, and keeping your Compasses at the same distance, set one Foot in *G*, and with the other draw the Arch *M*, the Right Line *L B D*, drawn through the Intersections of those two Arches shall be Perpendicular to *D G*, from the Point *L*, as was required.

But if it were required to let fall a Perpendicular from the point *E*, upon the Line *A B*, draw the Line *E D C* at pleasure, which being bisected at *D*, upon *D* as a Centre at the distance of *E D*, draw the Arch *E A C*, so shall the Line *E A* be Perpendicular to *A B*, as was required.

Propo-

Proposition III.

To Divide a Right Line given into any Number of equal parts.

Draw the Line *A C*, and from the points *A* and *C* erect the Perpendiculars *A E* and *X C*, and at any distance of the Compasses, set off as many equal parts as you please upon the Perpendiculars *A E*, and *X C*, and draw the Parallel Lines *E X, F V, G T, H S, K R, L Q, M P,* and *N O*; And let it be required to Divide the Right Line into three equal parts, open your Compasses to the length of the Line given, and setting one Foot in *A*, where the other Foot shall touch the third Parallel, make a mark, which is at *Z*, draw the Line *A Z*, so shall the Line *A Z* be Divided into three equal parts, as was desired.

And thus may that Line be made, which is commonly called the *Diagonal Scale.*

Proposition IV.

How to Divide a Circle into 120 *Parts, and by consequence into* 360.

Draw the Diameter *B C*, and upon the point *A*, describe the Circle *C D B L*, then draw the Diameter *D A N*, at Right Angles, to the Diameter *C A B*.

2. The Semidiameter or Radius of a Circle will

will divide the Circle into 6 equal parts, and so is equal to the Chord of 60 Degrees, *A C*, therefore being set from *D* to *F*, shall mark out the Arch *D F*, 60 Degrees.

—3. The side of a *Pentagon* or fifth part of a Circle, is 72 Degrees; now then, if you bisect the Radius *A C* in the point *E*, and make *E G* = *E D*; then shall *D G* = *D M*, the side of a *Pentagon* or Chord of 72 Degrees, and *F M* the difference between *D M*, 72 and *D F* 60, that is the Chord of 12, which by bisection shall give the Chord of 6 and 3 Degrees, and so the Circle may be Divided into 120 parts, as was propounded.

4. A Circle being thus divided into 120 Degrees, the Arches are so equal, that the third part of the Chord of 3 Degrees will subdivide it into 360, without sensible errour; and your Circle being thus Divided into 360 parts, Lines at every Degree, or half Degree, drawn parallel to the Diameter, shall constitute the Line of Chords, and half those Chords, the Line of Sines; and the Segments of the Diameter, the Line of Versed Sines, and as for the Tangents and Secants, a Line touching the Circle drawn perpendicular to the end of the Diameter, and continued to the several Lines drawn from the Centre, through every Degree of the Quadrant, shall constitute the Line of Tangents, and those Lines drawn from the Center to the Tangents, shall constitute the Line of Secants also. And thus may a Scale be

F   made

made with the Lines of Sines, Tangents, Secants, and equal parts.

CHAP. II.

Of Right Lined Triangles.

Hitherto we have spoken of the first kind of *Magnitude*, that is, of Lines, as they are considered of themselves, or among themselves.

2. The second kind of Magnitude, is that which is made of Lines, that is a Figure.

3. A *Figure* is that which is every where bounded, whether it be with one only limit as a Circle; or with more, as a Triangle, Quadrangle, Pyramis, or Cube, &c.

4. The terms or limits of every Figure are either Lines or Superficies.

5. A Figure which is terminated by Lines, is a Superficies.

6. A Figure, which is bounded or limited with several Superficies, is a Body or Solid.

7. A Superficies is a Magnitude, consisting of length and breadth, and is either Right Lined, Curve Lined, or composed of both.

8. A *Right Lined Plane* or *Superficies*, is that which is Terminated with Right Lines; and it is either a Triangle, or a Triangulate.

9. A

9. A *Triangle*, or the firſt Right lined Figure, is that which is comprehended by three Right Lines. It is diſtinguiſhed from the Sides, or from the Angles.

10. In reſpect of the Sides, a Triangle is either *Iſopleuron*, *Iſoſceles*, or *Scalenum*.

An *Iſopleuron Triangle*, is that which hath three equal ſides. An *Iſoſceles*, which hath two equal ſides. And a *Scalenum*, whoſe three ſides are all unequal.

11. In reſpect of the Angles, a Triangle is either Right or Oblique.

12. A *Right Angled Triangle*, is that which hath one Right line.

13. An *Oblique Angled plane Triangle*, is either Acute or Obtuſe.

14. An *Oblique and Obtuſe Angled plane Triangle*, hath two Acute Angles and one Obtuſe; an Acute angled Triangle hath all the three Angles Acute.

15. The ſecond ſort of Right lined Planes is called a *Triangulate*, or a Plane, compoſed of *Triangles*.

16. The ſides of a Triangulate, are in number more by two than the Triangles, of which it is compoſed.

17. A *Triangulate*, is either a *Quadrangle*, or a *Multangle*.

18. A *Quadrangle*, is a Plane comprehended, by four Right lines, and is either a *Parallelogram* or a *Trapezium*.

19. A *Parallelogram*, is a Quadrangle, whoſe

F 2 oppo-